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GENERAL ENGINEERING HANDBOOK

Editor-in-Chief: CHARLES EDWARD O'ROURKE
Assistant Professor of Structural Engineering, Cornell University

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TABLE OF CONTENTS

Dugald Caleb Jackson Awarded the Fourth Lamme Medal 1
The Year Ahead. H. S. Evans, President 3
Whither Are We Traveling? Harold S. Boardman 4
Minutes:
Meetings of the Council 13
Meetings of the Society 18
Address of Welcome. E. C. Elliott 27
Report of the Secretary. F. L. Bishop 31
Report of the Treasurer. W. O. Wiley 37
Report on the Summer School for Engineering Teachers. H. P. Hammond 39
A Study of Engineering Enrollments. Walton C. John 50
The Placement of June, 1931, Engineering Graduates 62
T-Square Page. F. G. Higbee, Editor 63
Machine Design Clearing House. F. L. Eidmann, Editor 64
Report of Conference on English. Sada A. Harbarger 68
College Notes:
Case School of Applied Science 70
Rensselaer Polytechnic Institute 70
University of Vermont 71
Worcester Polytechnic Institute 71
Sections and Branches: Middle Atlantic Section 73
Necrology: Arthur Henry Hoffman 76
Book Reviews 77

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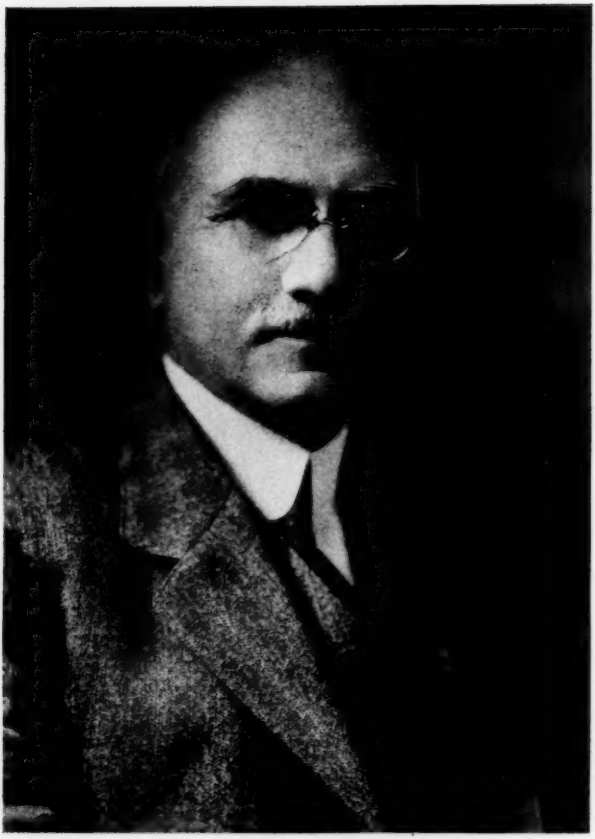

DUGALD CALEB JACKSON

DUGALD CALEB JACKSON AWARDED THE FOURTH LAMME MEDAL

Dugald Caleb Jackson, Professor of Electric Power Production and Distribution, in charge of Department of Electrical Engineering, Massachusetts Institute of Technology, was awarded the fourth Lamme medal by the Society for the Promotion of Engineering Education at its thirty-ninth annual meeting at Purdue University, June 17–19, 1931.

Professor Jackson was born at Kennett Square, Pennsylvania, February 13, 1865. After graduating in Civil Engineering at Pennsylvania State College in 1885, he spent the following two years in graduate study in Electrical Engineering at Cornell University. In his early industrial experience he was associated with the Western Engineering Company, at Lincoln, Nebraska; then connected with the Edison interests as Assistant Chief Engineer of the Sprague Electric Railway and Motor Company, and later as Chief Engineer of the Central District of the Edison General Electric Company. From 1891 to 1907 he was Professor of Electrical Engineering at the University of Wisconsin and since 1907 has been Head of the Department of Electrical Engineering at Massachusetts Institute of Technology. In this capacity and as a member of the firm of Jackson and Morland, consulting engineers, he has attained international prominence.

His influence as an engineer and educator is evidenced by his many associations and activities. He was Lt. Colonel in the engineering corps in France during the World War; Member of the International Jury, Chicago Exposition, 1893, and the Buffalo Exposition, 1901; Chairman of the Research Committee on Industrial Illumination, 1926–; U. S. Government Delegate to the World Engineering Congress, 1929; Chevalier, Legion of Honor (France); President of the A. I. E. E., 1910–11; President of the S. P. E. E., 1905–06; Member of the Board of Investigation and Co-ordination of the S. P. E. E.; Member of the American Academy of Arts and Sciences, the American Physical Society, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institute of Electrical Engineers (London), Société Française des Electricians (Paris), and American Institute of Consulting Engineers; President of the Boston Society of Civil Engineers, 1922–23.

Professor Jackson's broad vision, energy and leadership have been a powerful influence in all of his many activities. He stands

in the front rank of the educational leaders of the country, as an inspiring teacher, author of textbooks and administrator. To him is due credit and honor not only for the excellence of the task he has done at Massachusetts Institute of Technology but for his many other achievements in the field of engineering and the promotion of sound instruction and research fundamental to it.

THE YEAR AHEAD

By H. S. EVANS, *President*

If we as engineers and engineering educators are to continue to be worthy of the positions which we hold, we must retain that spirit of youth which is always looking into the future with hope and confidence. On the other hand, if we are to accomplish the worthwhile results which should be the outgrowth of mature years and experience, we must stop frequently and look back over the road that has been travelled by ourselves and others.

If this is true for an individual it is equally true for our Society. We must go forward with confidence; but if each engineering teacher would set himself a course of reading and study in the Proceedings of this organization and in the completed reports of the Board of Investigation and Coordination, the progress in engineering educational methods would be much more rapid.

My special plea, therefore, is that some of our most active workers in each engineering college should constitute themselves a committee with the particular objective of carrying a knowledge and understanding of the work of the S. P. E. E., both past and present, to our members with whom they come in contact, and not to our members only but to all those who are interested in engineering education.

Would it not be possible for our faculty groups to meet more frequently for more or less informal discussion of our common problems? Can our headquarters office be of assistance in suggesting topics for such meetings?

Most of us have a constantly growing appreciation of the responsibilities that are being laid on the engineer. During the formal educational process he must be given a thorough training in the fundamentals of science, but more than this he must also be a broadly educated man with an understanding of economics and of human relations and with a deep interest in the undoubted interdependence of human progress and industry. In the attainment of these results the teacher and the engineering college are the prime factors.

Let us work together for a more active interest on the part of our members, and also for an increase in the membership, in order that the influence of the Society may be broadened and that the data which have been accumulated may be used more intelligently.

WHITHER ARE WE TRAVELING?*

PRESIDENTIAL ADDRESS

BY HAROLD S. BOARDMAN

President of the Society, President of the University of Maine

We are assembled today as members of this Society to further the "promotion of the highest ideals in the conduct of engineering education with respect to administration, curriculum, and teaching work, and the maintenance of a high professional standard among its members." We pose as educated men. Thereby we assume the right to act as guides and councilors in the development of engineering education in the various teaching institutions of this country.

The Society had its birth 38 years ago. It was before the dawn of present day demands. It was at a time when only a far reaching vision could look into the future and prophesy the needs to come. It must be that the founders and early members had something at least of this vision. They builded even better than they knew. The Society has indeed become a real power in influencing engineering education and in developing high engineering professional standing. If this influence has led along the main path without being deceived by false appearances, and thereby being enticed into unimportant side paths, then surely the Society should receive the commendation of all. If, however, it has deviated from the main path, ever so little, we should become conscious of it and attempt to become oriented.

The longer I am connected with education the more prone I am to ask myself questions. Yet I must admit that a large majority of them never receive a satisfying answer. If, therefore, I ask one or two pertinent questions in the course of this address without volunteering an answer I shall be running true to form and shall at least have the satisfaction of passing these same questions on to you to attempt to answer or not as it may please you.

In the first place, what is education? I do not mean the dictionary definition, but when is one truly educated and what is the process of arriving at such a state? An answer to the latter

* Presented at the 39th annual meeting, S. P. E. E., Purdue University, June 17–19, 1931.

part of this question may be given by a study of the development of higher education in this country. A review reveals that institutions of the type of Harvard, patterned after the English system, were the first to become available. They in the beginning existed chiefly for the training of the clergy. Soon law, teaching, medicine and business appeared. Schools of law and medicine came later. The basic courses were Greek, Latin, Philosophy and Mathematics. From these colleges and professional schools grew our great endowed Universities which are now known throughout the civilized world. For many years these institutions catered to an aristocracy of learning and the lowly born stood very little chance within their walls.

During the middle half of the nineteenth century the newer states created State Universities supported and controlled by the commonwealth. These institutions were only slightly more liberal than the older institutions in that they recognized the Sciences. They, however, did not recognize any duty to the industries or the industrial classes and while in theory some of them at least were supposed to become a part of the public school system, in practice they fell far short of this plan. During this same period some far seeing people urged the National Government to take a hand in helping to supply an entirely new and novel kind of education. After years of effort, seeming to meet at times a complete failure, Abraham Lincoln signed on July 4, 1862, what is known as the Morrill Act or Land-Grant College Act, and our Agricultural and Mechanical Colleges were made possible. It is a matter of history regarding their development. At first looked upon with contempt by the so-called educated people and the privately endowed institutions, they were born in obscurity and their early life may well be compared to that of the Great Emancipator himself who by act of his pen brought them into being.

The growth and development of these three types of institutions have been the means of furnishing most of the opportunities for higher education in this country. A careful study of the history of education reveals many interesting facts, which although important cannot find a place in a short address. One is struck by the ultra conservatism in some sections of the country and the liberal tendencies in others. Also by the many problems in education and finance in evidence, some of which may well take their place in the calendar of the present day. We are likely to feel that our problems are new and while we admit our predecessors had them to solve, we sometimes think that they were different and that the solutions under former conditions were probably much easier.

A recent number of an educational magazine called attention to the fact that there is little new under the sun even in the philosophy of College administration, and cited the inaugural address of the first president of Wesleyan just one hundred years ago. Speaking on the subject entitled the "Science of Education," one of his opening sentences is very pertinent to the present as are many others. He says "as antiquity is not always perfection, so innovation is not always improvement. While, therefore, we ought to be wholly uninfluenced by unprofitable traditions, however ancient and authoritative, we ought also to be equally guarded against doubtful and hazardous experiments, however specious and imposing."

What was termed by the magazine writer as the most revolutionary suggestion in the inaugural was his suggestion of an elective system which he was unable to carry out on account of lack of funds. This suggestion came many years before Doctor Eliot of Harvard and others had worked it out and put it into operation. In a day when the classics were still dormant in collegiate education, this new leader boldly asserted that although they were valuable, other subjects were more valuable for most students. He declared that "modern literature, the natural and exact sciences, and the application of the sciences to the useful arts are of first importance in a useful education." He said, "next in order I would place mental and moral philosophy, and the kindred sciences; last, and least in consequence for the great portion of students, I would bring in ancient literature, the graces of learning, and the fine arts. But such is the character of modern literature and of the sciences, that a few only need devote themselves to ancient literature, in comparison with the many who can be better employed in other studies." He even went so far as to place a degree given without work in the classics on the same plane as one given for work in them.

Calvin Coolidge recently declared that "Democracy without the classics, government of the people, for the people, by the people without the spirit underlying Greek and Latin, must remain forever unthinkable." He, however, apparently meant to convey the thought that we should not forsake the *spirit* of the classics rather than that all education should be based upon them.

Contrast the privileges of free thought and action of the present age of experimentation and research with that of the time of Galileo in the sixteenth century when Bruno was hunted from land to land, imprisoned for six years in the dungeons of the Inquisition at Rome, and finally burned alive and his ashes scattered to the four winds of heaven—and all this done because

he had courage enough to advance the teachings of Copernicus, who before his death claimed that the earth revolved about the sun. Soon after, Galileo took up a defense of this theory and made certain discoveries, but to save his life he was forced to recant and sign the following oath. "I, Galileo, being in my seventieth year, being a prisoner and on my knees, and before your eminences, having before my eyes the Holy Gospel, which I touch with my hands, abjure, curse and detest the error and the heresy of the movement of the earth." From that day for many years science was one step ahead of religion, but was constantly being held back by those whom we now call fundamentalists. We still have controversies between the teachings of science and religion and even now there is a decided reaction against any new and radical proposal. For instance there are so-called eminent scholars of the present who laugh to scorn the Einstein Theory. It may be that this theory, even when viewed in the light of the present day, is as radical as many of the so-called heresies of long ago, but I doubt it.

Educational experimentation has been increasing by leaps and bounds, especially during the past 25 years. The reports of these experiments together with theoretical proposals and criticisms fill reams and reams of published material. If one should attempt to read all of these publications he would have little time to do else. Not only do they deal with experiments and proposals but that curse of the times for an administrator, the questionnaire, has been worked with such persistence that any question anyone wants to gather what are termed "facts" upon, is immediately incorporated in this abomination and circulated among the brethren. If this were the end it would not be quite so bad, but after studying the mass of "facts" gathered by this means they must be published for the sake of preserving for posterity such valuable information. I admit some of such material is good but it takes too much time to sift the good from the worthless. The person who gathers "facts" and figures too often fails to take account of hidden factors. This is likely to result in weak premises upon which are based conclusions which are misleading. I agree with a recent writer who, after discussing certain investigations which he had made, concluded that instead of following a criterion based upon his investigations he might just as well substitute a rule of thumb based upon the percentage of red headed students.

Then there is the "survey." This is not quite so bad as some of the other activities because it costs money to make the worthwhile survey and the lesser activities along this line are thus eliminated. But even this is carried in some cases to extremes. There are of course many valuable surveys and among

the number may be cited the Report on the Investigation of Engineering Education sponsored and conducted by this Society under the direction of the Board of Investigation and Coördination. This report has been published and widely circulated. Even this has received severe criticism.

In these remarks I do not wish to appear against educational research—only let us make it real research and not a frothy substitute. It may be that even the latter is a good omen, and it may indicate a healthy attitude upon the part of our present day educators. We do well to submit our activities to the "acid test" provided we know how and where to use such a test.

I wonder how many have read a recent presidential report of Nicholas Murray Butler in which he calls attention to the decline and fall of classical scholarship and classical teaching in American education, largely brought about as he says by the attitude and influence of teachers of the classics who saw fit to supplant understanding of the ancient world with unimportant specialization, "and to push far into the background the vitally important art of interpretation which is the essential element of real teaching." He says "it came about that in time classical studies in the schools and colleges of the United States were first asphyxiated, then embalmed, then incinerated, and finally placed in well decorated funeral urns in the academic columbarium by those who should have been their glad and eager companions." Going on he says that "the academic subjects whose rise contributed powerfully to pushing the classics into the background appear now to be themselves in danger of coming under the influence of forces wholly similar to those which have destroyed the prestige of the ancient classics," and further declares that "there are not wanting signs that teachers and research workers in the field of natural and experimental science may yet do for their favorite knowledges precisely what the teachers of the ancient classics have done for an understanding of the life and literature of ancient Greece and Rome. . . . It would indeed be a cruel fate if the natural and experimental sciences, after their full half century of increasing educational dominance and with their quite unlimited educational possibilities, were now to be sent the way of the ancient classics, and should come to be generally used and known only in their applied and technical aspects, primarily for economic reasons and from motives of gain." President Butler's report is well worth reading in full. You will probably not agree with all of his conclusions but at least it will develop real questions in your minds as to whither we are traveling in the educational field.

If it is true that the tendencies of the times are to be dom-

inated by balance sheet considerations rather than by considerations of human betterment, and that the yardstick of success is considered to be dividends, and that infinitely more attention has been paid to creating better machinery than to creating better men, then we should stop, look, and listen.

The present depression in our business world has, it is said, thrown over six million people into idleness in this country. We who are well fed and comfortable do not realize the suffering and privation that has been and is in our midst. It is said that Communism and Socialism and other revolutionary isms are making alarming headway in this great and good land of ours. We are likely to give such reports only a passing thought and conclude that Democracy is too firmly established for any movement of that kind to take any deep seated root. I wonder if this is true? How often could the laboring classes of this country withstand a recurrence of this deplorable state with its attendant starvation, crime and discontent without turning in desperation to anything which held out promise of permanent relief?

The latter part of the eighteenth century saw the beginning of a great experiment when this country was formed under a constitution founded upon principles of equal rights and privileges. For over one hundred and fifty years education has played a most important part in its development. Although far from perfect the experiment has succeeded far beyond the dreams of our forefathers. Now a new experiment is underway in a far distant country, and whether we like it or not we are forced to admit that Russia in attempting, on a gigantic scale, her program of Communism, not satisfied to confine the attempt within her own borders, may become a menace not only to us but to the entire civilized world.

A Representative in Congress, a member of the Fish Committee appointed to study the activities of the Communists, after discussing this very complete organization of the Communist Party of the United States of America, Section of the Communist Party of Moscow, declared the scope of the campaign to be without parallel in history, apparently seeking the destruction of all principles on which Western civilization depends. The Party teaches its adherents that our Government is dominated and controlled by the Capitalist Class and it seeks to prepare the masses for revolution and dictatorship.

He declared that workers have made their influence felt in our Army, our Navy, in the American Legion, and in our schools and colleges as well as in the factories and in the ranks of the unemployed. Speaking of the spread of Communism among the youth of America he said—"America has no more vicious and

dangerous enemy than he who seeks to plant in the minds of American youth the seeds of disloyalty and revolution. Youth with its idealism, lacking in judgment, often is most susceptible to those teachings."

It is reported that Communists have two organizations for American young people, the Young Pioneers of America, for children between 10 and 15, and the Young Communist League, for boys and girls from 15 years on. At 21 they are taken into the Party. They are establishing summer schools all over the country for the purpose of putting over their program.

But Communism, although doing a tremendous harm, especially among the foreign born, can make no menacing headway here if organized labor develops and maintains an attitude of loyalty to American government principles and as long as American education takes the right path. If either or both of these fail we shall be at the mercy of destructive forces, and our downfall will be the most stupendous in the history of the human race. The best way to fight an idea is with a better idea. We must then keep Democracy superior to Communism.

In these rapidly changing times youth is confronted with conditions much different from those prevailing during the life of our forefathers or even during a larger part of that of our fathers. This has a tendency to create misunderstandings and differences in the viewpoints of many problems. Many of the misunderstandings will be rendered impossible if, and when, a way is found so that men may have a closer relation in their thoughts and actions. It has been said that the man under forty should have a close association with those over forty in order to profit by the wisdom of old age, and thereby stabilize his activities. Also that the man of more mature years needs the companionship of youth in order to keep him in touch with the springtime of life. By this means he is better able to understand the viewpoint of youth and at the same time keep an elasticity of thought, the combination of which must result in a better balanced mind.

What, then, is the future of education? Whither are we traveling? Will the future show that we have built upon firm and sound foundations, or are we blindly following a forlorn hope? When the present and future have passed into history and are viewed in the cold light with which we now view the past, will we and our immediate successors be accorded praise or blame? Who can tell? We know we make mistakes, but do we profit by them?

I often think of the story of the rich man who late in life gave an immense sum to build a great cathedral. He watched its construction as it mounted block by block, and arch by arch, and

visualized its final form and grandeur. One day, as he stopped to watch the workmen, he spoke to one of them and asked him what he was doing. He replied, "Can't you see? I'm cutting stone." He asked the same question of a second man and he replied, "I'm drawing five dollars a day." But when the third man replied to the question he looked up with a rapt expression on his face and said, "I'm helping to build a great Cathedral."

It would seem that the many thousands of earnest educators, each working toward an ideal as he sees it, would be able to bring this beautiful land of ours to ever increasing success and glory through a proper and right education of her youth. Each succeeding generation has a mighty duty to perform in preparing those who come after to take up the burden and carry on.

I have faith to believe that if in the ages to come I am able to view from afar the land of my birth, I shall not only be proud of the work of our generation but of that of all those who succeed us.

The following poem by Hezekiah Butterworth is so apropos that I venture to give it in closing:

THE TAPER

I stood in the old cathedral
  Amid the gloaming cold
Before me was the chancel,
  And unlit lamps of gold.

From the mullioned window's chalice
  Was spilled the wine of light,
And across the winter valleys
  Was drawn the wing of night.

The frescoes of the angels
  Above me were unseen
And viewless were the statues
  Each pillared arch between.

The chancel door swung open;
  There came a feeble light,
Whose halo like a mantle
  Fell o'er the acolyte.

And one by one he kindled
  The silver lamps and gold,
And the old cathedral's glories
  Before my eyes unrolled.

The taper's light was feeble,
  The lamps were stars of flame;
And I could read behind them
  Immanuel's wondrous name.

The taper—light's evangel—
  Touched all the chandeliers,
As if by Heaven transfigured
  Appeared the saints and seers.

Along the sculptured arches
  Appeared the statues dim,
And pealed the stormy organ
  And peaceful advent hymn.

And as the form retreating
  Passed slowly from my sight,
Eclipsed in lights it kindled
  Was lost the taper's light.

One taper lights a thousand,
  Yet shines as it has shone;
And the humblest light may kindle
  A brighter than its own.

MINUTES OF THE MEETINGS OF COUNCIL AT PURDUE UNIVERSITY, JUNE 17, 19, 1931

Present: H. S. Boardman, C. F. Harding, R. A. Seaton, W. O. Wiley, F. L. Bishop, Paul Cloke, C. S. Coler, R. C. Disque, H. S. Rogers, I. C. Crawford, R. C. H. Heck, H. H. Higbie, W. C. Huntington, N. C. Riggs, W. H. Timbie, L. E. Akeley, W. E. Farnham, F. V. Larkin, J. E. McDaniel, D. C. Jackson, F. E. Turneaure, G. C. Anthony, M. S. Ketchum, C. F. Scott, A. A. Potter, G. B. Pegram, O. M. Leland, A. N. Talbot, W. T. Magruder, and Messrs. E. J. McCaustland, H. P. Hammond and W. E. Wickenden.

The report of the Secretary was read and ordered printed.

The report of the Treasurer was read and accepted and a vote of thanks extended to Mr. Wiley for his excellent services to the Society.

Chairman Wickenden presented the report of the Committee on the Advisability and Practicability of Classifying Engineering Colleges. The report will be printed in THE JOURNAL OF ENGINEERING EDUCATION. Council accepted the recommendations that no action be taken by the Society for at least one year; that the work of the Committee be continued and that special attention be given to the possible joint action of the national engineering societies and the national Council of State Boards of Engineering Examiners; and that a co-operating committee be appointed to investigate the alternative of comprehensive examinations for graduates.

The report of the Committee on Personnel Directors and College Professors was read by title and will be printed in the JOURNAL.

Chairman Rogers presented the report of the Committee on Personnel Methods in Use in Engineering Schools. This was accepted and will be printed in the JOURNAL.

Director Hammond reported on the five years' work of the Society in conducting summer schools for teachers of engineering. The report will be published.

Charles F. Scott, Chairman of the Board of Investigation and Coördination, reported on the future of the summer schools.

It was the sense of the Council that the summer schools should be continued under the direction of the Board of Investigation and Coördination and that the necessary funds should be raised, if possible.

Invitations to hold the 1932 meeting were received from the

University of Wisconsin, the University of Missouri, the University of Texas, and the Oregon State College. The invitation to meet at the Oregon State College in July, 1932, was accepted.

The application of the Texas Technological College for institutional membership was referred to the Executive Committee for consideration and report to the Council later.

The Division of Engineering Drawing presented the following resolution: "Resolved: That the Division of Engineering Drawing request the Council of the Society to consider the advisability of making the chairmen of the various divisions members of the Council." Council voted to accept the communication and to transmit it to the Executive Committee for consideration and report.

Chairman Coler reported that the Committee on Lamme Award had no recommendation to make in regard to the publication of a booklet. The Committee presented the following for consideration:

1. The advisability of starting a collection for enlarged pictures of recipients of the Lamme Award and this to be hung in the Engineering Societies Building in New York City.

2. Enlarged photographs of recipients suitable for framing be provided by the Society so that any school which desired to have them for the benefit of the faculty could receive them through the Secretary's office.

Recommendations approved by the Council.

The Institutional Division presented the following action of that body:

"Moved: That the Society for the Promotion of Engineering Education appoint a committee to study the project of a comprehensive examination at the end of the sophomore year, and the problem of a comprehensive entrance examination; that this committee coöperate with the Coöperative Test Service, the Engineering Foundation, and other institutions or agencies who may become active in this field; and that this committee be directed to report its findings and recommendations at the next annual meeting of the Society."

Col. Rees' committee working with the Engineering Foundation requested that the Society coöperate in securing such objective achievement tests as are in use in our more advanced subjects for study and analysis by Dr. Ben Wood, to whom the work has been turned over. The committee undertook to collect such tests informally before the S. P. E. E. was prepared to take that over and do it itself.

Motion that a committee consisting of D. C. Jackson, Chairman, H. P. Hammond and R. I. Rees be appointed by the council to consider this whole situation and recommend to the Council the best action to take in regard to the two matters.

Chairman Seaton, Sections and Branches, reported progress in the formation of sections and branches during 1930–31. Council approved the formation of the Colorado Schools of Mines Branch, the Arkansas-Oklahoma Section and the Texas Branch.

Council endorsed the 200th birthday anniversary of George Washington.

The place of illumination in the engineering curricula was referred to a committee consisting of C. F. Scott, Chairman, H. H. Higbie, D. C. Jackson, and F. C. Caldwell.

Council approved the appointment of a safety committee to cooperate with the A. S. M. E. Safety Committee.

The American Association of University Professors asked this Society for an expression of attitude and opinion in regard to the coöperative action in dealing with problems of academic freedom and tenure. The matter was referred to the Executive Committee for such action as it deems expedient.

Chairman Hammond for the Committee on Policy reported that no action be taken by the Society in regard to the dismissal of members of the faculties of institutions in the state of Mississippi.

Last year Council voted to recommend to the Society that the name of the Society for the Promotion of Engineering Education be changed to Engineering Education Society. During the year a letter ballot was taken with regard to a straw vote and 34 members voted, 17 for a change and 17 opposed. The Executive Committee decided not to present the matter to the members until after the Council meetings at Purdue in 1931.

A member of Council who voted in the affirmative last year made a motion that the whole matter be considered at this time. Carried.

Motion that Council recommend to the Society that the name of the Society for the Promotion of Engineering Education be changed to Engineering Education was lost by a majority—7 in favor and 22 opposed.

The following budget for 1931–31 was approved:

Receipts

Individual dues	$ 9,500.00
Institutional dues	1,785.00
Back dues	700.00
Advertising	1,500.00
Sale of publications	500.00
Interest on deposits	250.00
Estimated receipts	$14,235.00

Disbursements

A. 1931 Meeting	$ 500.00	
B. Journal, Proceedings and Year Book	7,000.00	
C. Committee expenses	150.00	
D. Secretary's honorarium	1,200.00	
E. Clerical assistance	3,300.00	
F. Sundry printing	300.00	
G. Postage, telephone and telegraph	350.00	
H. Supplies	200.00	
I. Traveling expenses	500.00	
J. Dues:		
American Council on Education	100.00	
American Engineering Council	225.00	$13,825.00
Estimated surplus	$	410.00

The following applicants were elected to membership:

BECK, LESTER E., Instructor in Electrical Engineering, Purdue University, Lafayette, Ind. C. F. Harding, A. A. Potter.

BROWN, CLEO A., Head, English Department, General Motors Institute of Technology, Flint, Mich. R. E. Robb, R. H. Spahr.

BROWN, LYNN T., Associate Professor of Mechanical Engineering, Iowa State College, Ames, Iowa. T. R. Agg, R. A. Norman.

CROFT, HUBER O., Professor and Head, Mechanical Engineering Department, University of Iowa, Iowa City, Iowa. C. C. Williams, S. M. Woodward.

CRUICKSHANKS, BENJAMIN C., Assistant Professor of Mechanical Engineering, George Washington University, Washington, D. C. Owen B. French, John R. Lapham.

DELABARRE, CECIL F., Instructor in English, Virginia Polytechnic Institute, Blacksburg, Va. C. M. Newman, P. T. Norton, E. B. Norris.

FAY, IRVING W., Professor of Chemistry, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. E. J. Streubel, H. P. Hammond.

GREGG, ROYAL B., Instructor in Practical Mechanics, Purdue University, Lafayette, Ind. J. D. Hoffman, A. A. Potter.

HENDERSON, JAMES M., Director, Department of Industrial Arts, Tennnessee Polytechnic Institute, Cookeville, Tenn. E. G. Young, N. H. Barnard.

HOYT, LAWRENCE B., Director of Engineering, Professor of Civil Engineering, Evansville College, Evansville, Ind. H. W. Fillmore, G. B. Marchant, A. A. Potter, M. B. Robinson.

NOBLE, PHILIP M., Instructor in Applied Mechanics, Kansas State College, Manhattan, Kans. R. A. Seaton, M. A. Durland.

NORDENHOLT, GEORGE F., Associate Editor, Product Engineering, McGraw-Hill Publishing Co., New York City. F. L. Bishop, Nell McKenry.

PARK, JOHN C., Assistant Professor of Civil Engineering, University of Arizona, Tucson, Ariz. F. C. Kelton, G. M. Butler.

PLUMMER, FREDERICK B., Chairman, Department of Petroleum Engineering, University of Texas, Austin, Texas. F. L. Bishop, Nell McKenry.

REYNOLDS, EDWARD E., Instructor in Electrical Engineering, Purdue University, Lafayette, Ind. D. L. Curtner, D. D. Ewing.

ROSS, DAVID E., Chairman, Board of Trustees, Purdue University, Ross Building, Lafayette, Ind. F. L. Bishop, H. S. Boardman, A. A. Potter.

RUGGLES, L. L., Supervisor of Personnel Training, Automatic Electric, Inc., 1033 W. Van Buren St., Chicago, Ill. R. I. Rees, O. W. Eshbach.

SCHUYLER, WILLIAM H., Assistant Professor of Chemical Engineering, North Texas Agricultural College, Arlington, Texas. H. D. McMurtray, F. L. Bishop.

TREZISE, FREDERICK W., Associate Professor of Engineering, Lawrence College, Appleton, Wis. F. L. Bishop, Nell McKenry.

TRUEBLOOD, RICHARD C., Instructor in Mechanical and Electrical Engineering, University of Wyoming, Laramie, Wyo. R. L. Rhoads, R. S. Sink.

Respectfully submitted,

F. L. BISHOP,
Secretary.

MINUTES OF THE REGULAR SESSIONS OF THE THIRTY-NINTH ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

The thirty-ninth annual meeting of the Society for the Promotion of Engineering Education was held at Purdue University, Lafayette, Ind., Wednesday, June 17 to Friday, June 19, 1931. The keynote of the meeting was "Research and Engineering Education." The regular meetings were held in the Eliza Fowler Hall.

Council held two meetings, the first a dinner meeting on Tuesday evening, at which they were guests of Purdue University, and the second a breakfast meeting on Friday.

Registration headquarters were in the main concourse of the Memorial Union Building. There were 712 members and guests registered.

At the Council meeting on Tuesday evening, Dean A. A. Potter, on behalf of Purdue University, presented to President Boardman a gavel made of wood from one of the historic farms near Purdue.

On Wednesday morning, June 17, there were six conferences held:

English, Sada A. Harbarger, *Chairman.*

Speech Training in Engineering Schools:

1. The Need for Speech Training for Engineers. James W. Parker, Detroit Edison Company.
2. Aims and Objectives in Speech Training for Engineering Students. A. H. Munroe, Purdue University.
3. Debating and Discussion Groups among Engineering Students. R. D. Brackett, University of Michigan.
4. The Professional Society and Speech Training. H. H. Higbie, University of Michigan.

Industrial Engineering, E. B. Norris, *Chairman.*

1. The Business Side of Engineering.
   Discussion led by Eugene L. Grant, Stanford University.
2. Discussion of the Desirability of Holding a Summer School for Teachers of Industrial Engineering or of Some Specific Phase of Industrial Engineering.
   Discussion led by H. P. Hammond, Director of Summer Schools, S. P. E. E.

Mechanics, A. P. Poorman, *Chairman.*

The Place of Mechanics in the Engineering Curriculum.

The Relation of Class Work in Strength of Materials to the Mate-

rials Testing Laboratory. G. P. Boomsliter, West Virginia University.

Pseudo Mechanics. E. R. Maurer, University of Wisconsin.

Business.

Electrical Engineering, Paul Cloke, *Chairman.*

Results of Study of Electrical Engineering Curricula of Ten Representative American Institutions. J. C. Clark, University of Arizona.

Discussion.

Coöperative Engineering Education, W. H. Timbie, *Chairman.*

A Coöperative Course in Public Service. G. R. Lowrie, University of Cincinnati.

Coördination between College Work and Industry. Carl L. Wildes, Massachusetts Institute of Technology.

Machine Design, F. L. Eidmann, *Chairman.*

The Selection of Design Engineers. Edwin H. Brown, Engineer, A. O. Smith Corporation, Milwaukee, Wis.

The Content of Courses in Machine Design and Related Subjects. James A. Hall, Brown University.

Reports of these conferences will be published in THE JOURNAL OF ENGINEERING EDUCATION later.

WEDNESDAY, JUNE 17, 1931

The opening session of the thirty-ninth annual meeting was called to order at two o'clock by the President of the Society, H. S. Boardman, President of the University of Maine. Edward C. Elliott, President of Purdue University, welcomed us to the University and President Boardman responded for the Society.

Vice-President Seaton took the chair and President Boardman delivered his Presidential Address, "Whither Are We Going?" In his address President Boardman asked "What is education?" He reviewed briefly the beginning of education in the training of the clergy, then law, medicine and business. "For many years institutions catered to the aristocracy of learning and the lowly born stood very little chance within their walls." He contrasted the privileges of free thought and action of the present age of experimentation and research with that of the time of Galileo. He closed his address with the belief that "the many thousands of earnest educators, each working toward an ideal as he sees it, would be able to bring this land of ours to ever increasing success and glory through the proper and right education of our youth."

D. C. Jackson, Massachusetts Institute of Technology, presented a paper on "Function of Research in Engineering Educa-

tion." The report of the Treasurer, W. O. Wiley, was read and accepted. The report of the Secretary, F. L. Bishop, was read and accepted.

At four o'clock, President and Mrs. Edward C. Elliott entertained the Society at a tea and reception at their home.

The Division on Drawing met at six o'clock dinner and the following program was presented:

Division on Drawing, H. M. McCully, *Chairman.*

1. Suggestions for Broadening the Scope of the Engineering Department of Engineering Drawing. Wm. E. Wickenden, Case School of Applied Science.
2. The Field of the Graphic Arts in Engineering Education. Thos. E. French, The Ohio State University.
3. The Artistic Side of Engineering Design in the Manufacturing Industry. F. C. Donner, The Westinghouse Electric and Manufacturing Company.
4. Art in Engineering Structures. N. D. Morgan, The University of Illinois.

Discussion

THURSDAY, JUNE 18, 1931

The second session was called to order at nine-thirty by President Boardman who turned the meeting over to Vice-President C. Francis Harding. A. A. Potter, Purdue University, presented a paper on "Coöperative Research." A. E. White, University of Michigan, read his paper on "The Administration of Engineering Research Activities." Walton C. John, Office of Education, gave a summary of enrollment in 145 engineering schools in the United States in 1930–31. H. E. Ives, Belle Telephone Laboratories, presented a paper on "Some Aspects of Research in Applied Physics." Secretary Bishop gave a report on "Employment of 1931 Engineering Graduates." These papers were discussed.

From one o'clock to three the members of the Society were conducted through the laboratories of Purdue University.

At three o'clock the Institutional members held a meeting with Vice-President Harding presiding. The following program was presented:

1. Selection and Admission of Applicants for Entrance to Engineering Colleges.
   a. How to Approach the High School Student with Engineering Information. W. H. Timbie, Massachusetts Institute of Technology.
   b. The Attitude of One College toward an Applicant for Admission who has Withdrawn from Another College Be-

cause of Low Scholarship. W. R. Halliday, Stevens Institute of Technology.

c. Standards of Selection and Admission to Engineering Colleges. O. M. Leland, University of Minnesota; C. G. Thatcher, Swarthmore College; C. H. Fulton, Missouri School of Mines.

2. Orientation of New Students.
   a. Administrative Methods. H. S. Rogers, Oregon State Agricultural College.
   b. Orientation Programs and Tests. H. H. Jordan, University of Illinois.
3. The First Two Years vs. the Last Two Years in the Engineering Schools.
   a. Comprehensive Examinations for Sophomore Engineering Students. F. V. Larkin, Lehigh University.
   b. Engineering Students from Junior Colleges and Arts Colleges. F. C. Bolton, A. & M. College of Texas.

At four o'clock the Divisions on Drawing, English, and Orientation and Engineering Problems held meetings:

Drawing, H. M. McCully, *Chairman.*

1. Beauty in Engineering—A Statement of Its Historical Background. J. Rexford Newcomb, The University of Illinois.
2. Survey of the Activities of Engineering Drawing Departments at the Present Time. Carl Lars Svensen, The Texas Technological College.
3. What May be Done in Elementary Drawing Courses to Develop the Artistic sense. F. M. Porter, The University of Illinois.

Discussion

4. Divisional Business Meeting.

English, Round Table: W. Otto Birk, *Chairman.*

Speech Training through Classes in Technical Subjects.

Orientation and Engineering Problems, F. C. Dana, *Chairman.*

Purpose and Values of Engineering Problem Courses as Related to the Philosophy of Engineering Education:

Relationship of Engineering Problem Courses to the Engineering Curricula. H. S. Rogers, Oregon State Agricultural College.

The Relationship of Engineering Problem Courses to the Courses in Physics and Mathematics. Louis O'Shaughnessy, Virginia Polytechnic Institute.

The Importance of Engineering Problems in Developing Skill in the Preparing of Computation Sheets. E. R. Wilcox, University of Washington.

The annual dinner was held in the ball room of the Memorial Union Building with President Boardman presiding. C. S. Coler, Westinghouse E. & M. Company, Chairman of the Committee on Lamme Award, presented the report of that committee and concluded the report with the recommendation "for the 1931 medal an educator who has helped to set the type of the present system of engineering education in the United States, a man who has always maintained high ideals in his work, a man who has kept his practices up to date, a man who has built up and developed an outstanding graduate program, a man who has throughout his years as an educator encouraged research, a progressive teacher, a capable engineer, a forward looking administrator, Dugald Caleb Jackson."

Past Presidents Charles F. Scott and G. B. Pegram escorted the recipient to the chair where President Boardman presented the fourth Lamme gold medal to Dr. Jackson with the citation: "Dugald Caleb Jackson, educator, engineer, research worker, soldier, writer, author, administrator, and member of many learned societies:

"Through your energy, common sense, broad vision, and analytical mind, you have attained international prominence, and you have become a leader not only in your profession but in other fields.

"The honor which we are about to bestow is given only after careful consideration. In selecting you as the recipient, we feel that we are indeed fortunate that one of our number has attained such undisputed prominence.

"It is our belief that you have set your ideals so high that even with so much to your credit you will not be satisfied and will do even greater things for the benefit of mankind. And now in the name of the Society for the Promotion of Engineering Education it is my privilege and pleasure to present you the Lamme Medal."

Professor Jackson accepted the medal with appreciation of the honor conferred upon him.

David E. Ross, Chairman of the Board of Trustees of Purdue University, spoke on "Research in Industry"; Edward C. Elliott, President of Purdue University, addressed the group, and John G. Bowman, Chancellor of the University of Pittsburgh, spoke on "Teaching." The remainder of the evening was given over to dancing.

FRIDAY, JUNE 19, 1931

The third session was opened at nine-thirty by President Boardman, who introduced R. B. Wiley, Purdue University, who read his paper, "Grades and Minimum Essentials." Discussion. H. P. Hammond, Director of the S. P. E. E. Summer Schools for Teachers of Engineering, made a report on the five years' work in that field.

"The Case Problem in Engineering Education was presented by F. A. Kartak, Marquette University, and the discussion was led by Wm. H. Timbie, Massachusetts Institute of Technology, and Arthur G. Anderson, University of Illinois. There was an exhibition of the case method in the Memorial Union Building.

The Nominating Committee presented the following report:

For President: H. S. Evans, University of Colorado.

For Vice-Presidents: H. H. Jordan, University of Illinois; D. S. Anderson, Tulane University.

For Treasurer: W. O. Wiley, John Wiley & Sons, Inc.

For Secretary: F. L. Bishop, University of Pittsburgh.

For members of the Council to serve three years: L. E. Conrad, Kansas State College; A. M. Dudley, Westinghouse E. & M. Company; F. L. Eidmann, Columbia University; B. G. Elliott, University of Wisconsin; A. E. Norton, Harvard University; G. A. Stetson, American Society of Mechanical Engineers; E. R. Wilcox, University of Washington.

Upon motion the nominations were closed and the Secretary cast the unanimous ballot of the Society for the nominees.

Past Presidents G. C. Anthony and Wm. T. Magruder escorted President-Elect Evans to the platform. Dean Evans said:

"Those of you who have attended the meetings of this organization for as many years as I have, or who have followed its doings through the publications and in other ways, have no doubt in your minds the high purpose and real accomplishments that have come from the Society for the Promotion of Engineering Education.

"A few years ago, through the vision of certain of our leading members, we had what might be called, I think, a renaissance and at that time this Board of Investigation and Coördination was created and organized. The work of that Board has progressed and now you have the reports in your offices and you know what results have been secured. I think we are all of the unquestioned opinion that all the effort and all the endeavor of the men who have been behind this movement has been very much worth while.

"It seems to me, however, now that we might compare ourselves to possibly the student who comes to us to receive an engineering education. You know when a high school student finishes his course he thinks he has reached just about the climax of knowledge.

and when he comes to us as a freshman he may have his faith shaken a little, but still he goes on pretty strong, and by the time he gets to be a sophomore he is sure he knows just about all. If he keeps on, however, and is the right type of man, by the time he is a senior he has arrived at the place in his education where he may be almost discouraged by the fact that he sees so much on ahead of him that needs to be done, and it appears quite hopeless to him. Still he goes on striving and working with greater enthusiasm.

"It seems to me we are in about the position of that senior just now. We have passed through many preliminary stages. We have had the investigation of this Board, and there has at times been a slight indication that there may be a let-down after that study. But actually, if we will look at it in a broadminded way, we will see it has simply laid out our problems for us and that now we can see ahead where there is much more for us to do in the future than we had ever dreamed of in the past. I think this organization should arise to that occasion and work even more vigorously to accomplish the results we have in mind.

"I want to express to you in what feeble words I can my great pleasure in having the opportunity given to me by this selection to serve as best I may as President of this Society for the next year. I want to ask the coöperation of all of us not only this next year but in every year in the future in our work and strife for those things that are better and best in engineering education. I believe that is our true goal and the ideal which we have in thinking about our work in our profession."

The report of the Committee on Resolutions was presented:

The Resolutions Committee of the 39th Annual Meeting of the Society for the Promotion of Engineering Education makes the following report:

Whereas the Annual Meeting held at Purdue University June 17–19, 1931, has been a source of inspiration and guidance to its members in the future promotion of engineering education and whereas this meeting has been made profitable and enjoyable through the efforts of many individuals and by the facilities and courtesies extended by Purdue University, therefore be it resolved:

1. That the Society express appreciation and thanks to President and Mrs. Edward C. Elliott of Purdue University for contributing to the social pleasures and advantages of the meeting by the reception in their home and to President Elliott for his constructive contribution to the annual program.

2. That the thanks and gratitude of the Society be extended to Dean A. A. Potter, of the College of Engineering, Chairman of the General Committee, and to all others of the Purdue University faculty who have so generously devoted time to the organization of

the functions and procedures that have made the meetings profitable and full of inspiration and pleasure.

3. That due appreciation and thanks be expressed to the Ladies' Entertainment Committee under the chairmanship of Mrs. G. A. Young for trips and social functions provided for the pleasure and entertainment of the visiting ladies of the Society, and for the care and supervision of the visiting children.

4. That the Society acknowledge with high appreciation the addresses delivered at the Annual Dinner by David E. Ross, President, Board of Trustees, Purdue University; Edward C. Elliott, President of Purdue University; John Gabbert Bowman, Chancellor, University of Pittsburgh, and that regrets be expressed to Hon. Harry G. Leslie, Governor of the State of Indiana, that the pressure of executive duties made it impossible for him to attend.

5. That the Society acknowledge the advantages of the cooperation of the Applied Mechanics Section of the American Society of the Mechanical Engineers in arranging the program of that section prior to the Annual Meeting of this organization. The privilege of attending this sectional meeting is highly appreciated by the Society for the Promotion of Engineering Education.

Move that these resolutions be adopted and that the Secretary of the Society be instructed to send copies to all those who have contributed to the success of the 39th Annual Meeting.

Respectfully submitted,

B. M. BRIGMAN,
H. B. DIRKS,
E. F. CHANDLER,
H. B. WALKER,
J. A. CORRELL,
W. M. COBLEIGH, *Chairman.*

The fourth session was called to order at two-thirty by Vice-President R. A. Seaton. H. S. Rogers, Oregon State College, Chairman of the Committee on Personnel Methods in Use in Engineering Schools, read the report of that committee; Wm. T. Magruder, Ohio State University, Chairman of the Committee on Recruiting, presented that report. The report on Instruction in Industrial Relations was read by O. W. Eshbach, American T. & T. Company, and the written discussion by C. E. Davies, American Society of Mechanical Engineers, was presented by G. A. Stetson of that Society. The report on the Advisability and Practicability of Classifying Engineering Colleges was read by title in the absence of W. E. Wickenden, Case School of Applied Science, Chairman. C. F. Scott, Yale University, Chairman of the Board of Investigation and Coördination, reported briefly for the Board.

Walter B. Jones, University of Pittsburgh, Chairman of the Committee on Junior Colleges, presented a paper on that subject. H. L. Babbitt, University of Illinois, presented a paper on "Inspection Trips." H. W. Brown, General Electric Company, delivered an address on "The Student's Preparation for Practical Engineering and Related Industrial Work," and R. A. Baxter, Colorado School of Mines, spoke on "Training Engineers for the Mineral Industries."

The meeting adjourned at four-thirty to meet at the Oregon State College, Corvallis, in July, 1932.

ADDRESS OF WELCOME

By E. C. ELLIOTT, *President*
Purdue University

Mr. President, Members of the Society: Those who claim to know, maintain that English is the most facile in expression and the most fertile of telling phrase of all the languages. On this occasion I covet all the qualities of a master of our tongue. It is certain that only a master could adequately express the sense of satisfaction and honor that we of Purdue University have from your presence here. My colleagues, especially those in the schools of engineering, have labored long and energetically, and have anticipated with enthusiasm your coming. I hope with them for the fulfillment of all of their plans. May this program, which your officers have so abundantly arranged, mark this thirty-ninth session as the outstanding event in the history of this Society.

I ofttimes wonder whether there is any reasonable justification for the existence in this country of the numerous associations for the promotion of education. A few days since, my curiosity having been aroused, I examined the official directory of the Office of Education. Unless my counting machinery went awry, there are almost 1,000 international and national and state and local organizations committed to the business of promoting education in some one of its phases. About half of these are, as this Society, national organizations. Not a few of these from time to time come to this campus. What purpose do they serve for Purdue University? For, indeed, I think we are not wrong when we assume that we play more than the part of hosts for this meeting. Naturally we are hopeful that your experiences here will furnish ample proof for the reputation which all of Indiana, and especially this particular side of the Wabash, has for being past masters at the gentle art of hospitality. But we expect to gain something ourselves aside from your approbation that we have been generous and watchful hosts.

I think the proverb is of Chinese origin—at least medical men assign it to the Chinese. I have observed that the medical profession, when finding a remedy that works in a fashion not otherwise explained, assign it to the Chinese. In this particular instance, our chief University Medical officer has been advising our students thus: "If you feel you must rub your eye, do it with your elbow." That, I believe, is a wise hygienic interdiction of the natural tendency to rub a troubled eye. You will not feel of-

fended, I am sure, if I say on behalf of Purdue University that we regard your session as a sort of Chinese elbow. We expect you, in your own ways, to rub our eyes in order that we shall have a clearer vision of our own tasks and our own responsibilities. If we have our own eyes opened, what about you?

Some eight years ago the National Industrial Conference Board prepared and published, in coöperation with this Society, a monograph on the relationship of engineering to industry. In my copy I have marked two paragraphs with a red pencil. On the first page, there is a statement, as I recall, that runs somewhat thus: that the primary purpose of the engineering school is to provide trained men for industry. That dictum is often in my mind, for it seems to be accepted as a professional law. Yet, in my humble estimation, that is not the exclusive business of engineering schools, unless we translate the word "industry" as meaning industrialized society.

Later on in this publication of the National Industrial Conference Board there is a prediction. Most of the thousand educational organizations, to which I referred a moment ago, seem to be engaged in several distinctly different things. First of all, they are trying to discover those subtle things which in science we call principles, especially principles of dealing with human beings. They are trying to lay out programs of action by which to apply these principles. They are trying to formulate plans for the promotion and expansion of the whole social enterprise of education. Above all they undertake the very difficult and dangerous adventure of prophecy. Those who prepared the report in question did all of these things, including the last. Therein it is said, in 1922, that by 1930 there would be needed at least 400,000 more trained men for industry than were needed in 1920. As I re-read that prophecy a few days ago, there seemed to march past me a long line of trained men who apparently are not needed by industry to-day. It is an idle intellectual sport to remind the prophet that he was wrong, and I would not claim the right of vengeance upon the authors of this prophecy.

Yet, Mr. Chairman, one cannot escape at this stage in the development of that professional training we call engineering training, the responsibilities of prophecy. What is the prophecy that may safely be made? I will endeavor to avoid the risk of doing damage to your program by prophesying for the Society for the Promotion of Engineering Education. In the first place, I predict that your name will be changed. It is rather late, after thirty-nine years, to propose mere changes of name. In my humble estimation, the time has come, not merely to promote but to *protect* that profession for which we are to-day providing training. Per-

haps the argument which is in my mind will be concentrated by reminding you of the extraordinary advances made during the last two decades in training for the medical profession. Has not the time come for us to begin the rigid classification of engineering schools in much the same way as twenty odd years ago the medical profession began to separate medical schools into Class A, or B, or C, thereby eliminating over half of the medical schools then flourishing in the country. I speak bluntly, for if engineering education is to be promoted and also protected, and if those who profess engineering may serve as capable prophets for the future, then it would seem that there must be provided a much more reliable guarantee to those seeking to be prepared properly for the professions of engineering.

The schools once rigidly examined and classified, attention should then be concentrated upon the quality of the human products of such institutions as yours and mine. This will involve, may I suggest, the putting into the technical degree something not now there. Think of the thousands of young men in this country during this month of June, 1931, upon whom has been conferred a degree in some part of which the word "engineering" is found. Think of the hundreds—perhaps I should say thousands—of men who have received those parchments which testify to their right to be called mechanical engineers, or chemical engineers, etc.; parchments awarded on the basis (if I may speak of the country as a whole) that seems to me to be wholly inadequate to represent the quality of the professional training needed by those who in this age play the part of engineers.

Taking advantage of my opportunity to welcome you to Purdue University, I say two things to you, Mr. President: The engineering professions need to be promoted through jealous and skillful internal protection; that protection can only be secured by recognizing that there are wide ranges of difference in value among these hundreds and hundreds of institutions in this country presuming to give to our ambitious youth the training fitting them for these world important professions. More than this must there be a new guardianship of the kind and quality and the amount of training that shall be received before man may claim to be engineers.

Why do I say these things? We have read so frequently during the last two years the pronouncements of politicians who are statesmen and statesmen who are merely politicians, of philosophers who are poets and poets who are philosophers, that the world to-day is leaderless.

As I read the declarations of the President of Columbia University in Paris last week in which he developed this theme, I ran

over in my mind those periods in the world's history dominated by classes of leaders. It would seem in human history that there have emerged not less than twelve forms of leadership. There is no time now for details. I merely read the names. Some of you might want to quarrel with me later on as to the soundness of my classification.

I do not defend the historic sequence, although it fairly accords with the development of the human race. First, was the mother whose leadership perhaps came to its social climax in the pre-historic days when matriarchy was the pattern of the rule of the world. Then we may follow the leadership acquired and held by the fighting man, the soldier; by your professional ancestor, the tool maker; by the trader, to be succeeded by the priest, the poet, the law-giver, and the artist. This brings us down to this modern age of our in which may be found four types of leaders, the physician, the farmer, the politician and the engineer.

Now to engineering is assigned the prime leadership in the affairs of the world to-day. Nowhere may be found better proof of this than that furnished in the volume recently published by Mr. Stuart Chase on the Nemesis of American Business, which has come onto our book shelves in the last two or three weeks. Therein I find one short, extraordinary and interesting chapter which has a very direct bearing upon the problem ahead of us, who are in any wise responsible for the training of men for this profession. The title of that chapter is "Prometheus Enchained." And Prometheus Enchained is the modern engineer.

Chase writes as the last sentences of that short chapter "Plato once called for philosopher kings. To-day the greatest need in all this bewildered world is for philosopher engineers." When I read that phrase, "philosopher engineers," I recalled that long line of young men, 400 or more, who passed before me a week ago and received the Purdue stamp of approval for their professional fitness. How many of them during their stay in this institution had had implanted in their minds the seed of what Chase calls "the engineering mind," the socially constructive mind that is not shackled exclusively to commerce.

Mr. President, if this Society is to furnish during the next thirty-nine years as full justification for its existence as it has during the last thirty-nine years, it must devise ways and means whereby there shall come into possession of the affairs of the world that which we may appropriately call the free and untrammeled engineering mind: the social philosopher in the world immediately to be must have the engineering mind. The engineer must have a philosopher's soul. It is with these thoughts that I welcome you to Purdue University.

REPORT OF SECRETARY, 1930–31

F. L. BISHOP

The past year shows distinct progress in the desire to do better teaching. The accomplishment of this is the greatest contribution the members of this Society can make to engineering education. This is illustrated by the interest which has been shown in the following activities of this Society:

1. *Meetings of the Society—Annual and Sectional.*—Sixteen educational meetings have been held under the auspices of the Society during 1930–31 with an approximate attendance of 1,500.

2. *Committee Work.*—There have been 180 members of the Society serving on various committees this year. All of these committees have definite projects, some of which extend over a period of years, a number reporting at each annual meeting. An outgrowth of this committee work is the eight conferences on various subjects which appear on the program for this meeting.

3. *Summer School for Teachers of Engineering.*—Two summer schools for engineering teachers were held in 1930—one in Drawing and Descriptive Geometry at the Carnegie Institute of Technology, and one in Civil Engineering at Yale University. There were in attendance at the former school 99 teachers and a staff of 20; at the latter, 88 teachers and a staff of 52.

4. *Presentation of Papers or Articles in the Journal.*—Ten per cent of our members have either written articles for the Journal or have appeared on one of the programs in sections or branches or at the annual meeting. This fact strikes me as significant since it means that each individual must have thought of his topic and have based it upon personal research.

5. *The Journal of Engineering Education*—There have been published during the current year in addition to the eleven numbers of the JOURNAL two extra supplements, the 1930 Survey of Engineering Education, and Engineering Research at the Colleges and Universities of North America.

COUNCIL

The Council is the legislative body representing the Society as a whole. In addition to transacting the routine business of the Society, council each year originates one or more projects. At its meetings in Montreal, June 25–28, 1930, Council authorized:

1. A committee to consider the advisability and the practicability of classifying engineering colleges.

2. The Committee on Lamme Award to consider and make definite recommendations concerning the publication of a booklet.

3. A committee on junior colleges to consider the relation of junior colleges in engineering and engineering schools.

4. A committee consisting of personnel directors and college professors to consider existing practices and to determine whether they best serve the three interests concerned and possibly some other plan of recruiting.

5. The appointment of a committee to consider engineering degrees as relating to the four founder engineering societies.

6. A survey of vocational guidance practices prior to enrollment and during the first year in engineering schools; study of personnel methods in use in engineering schools; and a survey of methods and procedures of administration for improving educational and instructional standards was referred to the existing committee with the urgent recommendation of the Council that they be studied intensively.

7. Council recommended to the Society that the name of the Society for the Promotion of Engineering Education be changed to Engineering Education Society.

8. That we continue the work of securing statistics through the Office of Education, Department of the Interior, and that a committee be appointed with General Rees as chairman to continue this work.

9. Plans for the Society's participation in the World's Fair in 1933.

All of these projects have been carried on successfully and at the proper time reports will be presented covering them.

During the year, Council voted, by letter ballot, on various matters so that at all times it was cognizant of the Society's affairs.

Membership

232 new members have been added to the rolls of the Society this year and three old members reinstated, making a total gain of 235. This is the largest in the history of the Society although in 1930 we added 218, and in 1923, 209. Upon recommendation of the Council 77 names were dropped from the rolls for non-payment of dues. We lost eleven by death—G. M. Braune, W. W. Carson, C. W. Gould, A. H. Hoffman, H. M. MacKay, C. I. Palmer, R. B. Poague, A. C. Prime, W. M. Towle, A. J. Wood, Ashby Woodson, and V. R. Yates—and 91 have resigned, making a total loss of 179, showing a net gain of 56. The total membership is

2,385, of which 119 are institutional and 2,263 individual members.

The increase in membership has four distinct periods; from its organization to 1905 showing a straight line increase; 1905 to 1916, a greater increase; 1916 to 1920, the membership was constant neither increasing nor decreasing. Since 1920 it has been increasing at a uniform rate. The increase in membership during the past two years, the largest in the history of the Society, is due directly to the coöperation of the individual members of the Society. The sectional meetings have been of great value in increasing the membership.

We have 17 life members on the rolls, four of whom paid the life membership fee—twenty times the annual dues—and thirteen placed on the list by action of the Council under Article II of the Constitution.

Publications

Each member has received the Journal of Engineering Education, the year book and two supplements, a total of 1,104 pages. The size of the printed page of the Journal was slightly increased in September from 23×40 picas to 25×43 picas; the size of the type was not decreased but the space between the lines was changed from 10 on 12 pt. to 10 on 11 pt.; thus increasing by approximately 100 the number of words on the page. This resulted in a decrease in the cost of the Journal. This cost was further decreased in March when the printing company notified us of a ten per cent reduction. It is of interest to note that each member now receives almost exactly twice as much in the Journal for $5.00 dues as he did five years ago for the same dues.

At the suggestion of Professor C. E. Tucker, Massachusetts Institute of Technology, the index of the Journal is published in the June number.

The publication of the year book early in the academic year has proved to be of distinct help to the members and should be continued.

The Proceedings of the annual meetings are published as they always have been during the thirty-nine years of the Society and are sold to subscribing members at $2.00 per volume and to libraries and to non-members at $3.00. All the material that appears in the Proceedings has been published in the Journal.

A page each month in the Journal is given to the Drawing Division and is known as the T-Square Page; to the Coöperative Engineering Education Division; and to English. The Clearing House for Machine Design has lately occupied a page.

The report on a Study of Technical Institutes by W. E. Wickenden and his associates has just come off the press. A forty-page summary is on the press and will be released shortly.

Dr. Wickenden is now completing his material for the second volume of the report of the Board of Investigation and Coördination on the investigation of engineering education. This will be mailed, during 1931–32, to all members who have paid their dues.

Sections and Branches

Vice-President R. A. Seaton, in charge of sections and branches, has done very effective work, as his report will indicate. The increased interest in sections indicates that this is one of the most promising factors in the future growth and influence of the Society.

Summer School for Teachers of Engineering

Two summer schools for engineering teachers were held in 1930—one in Drawing and Descriptive Geometry at the Carnegie Institute of Technology, and one in Civil Engineering at Yale University. There were in attendance at the former school 99 teachers and a staff of 20; at the latter, 88 teachers and a staff of 52. There have been seven schools conducted since the inauguration of this project in 1927, two in mechanics, one each in electrical engineering, physics, mechanical engineering, civil engineering and engineering drawing and descriptive geometry. There are two scheduled for 1931—chemical engineering at the University of Michigan, June 22 to July 9; and mathematics at the University of Minnesota, August 24 to September 5. A detailed report will be presented by Director Hammond.

An interesting feature is the annual reunion of the "Alumni" of the School of Mechanical Engineering held at Purdue in 1929.

Employment Service

The employment service in the Secretary's office has been continued as in previous years with a constantly increasing growth. This service is conducted without charge to employer or employee. Each year the Secretary writes to the deans of all engineering schools asking them for a list of vacancies to be filled during the coming year. A notice appearing in the JOURNAL notifies the members of this service. In addition to the 100 or more letters received from men who want teaching positions, many men visit the Secretary's office.

Lamme Award

The third Lamme medal for achievement in engineering education was awarded in 1930 to Charles Felton Scott. The first medal was awarded to George Fillmore Swain, the second to Irving Porter Church.

Trends in Engineering Education

Ten years ago at the 29th annual meeting of this Society at Yale University, the topics discussed were the curriculum, the student and the faculty. It was at this meeting that "the Society requested the Council to consider very carefully the appointment of a committee to carry forward the work which the Carnegie Foundation, under Dr. Mann, so well began." You are familiar with the results of the investigation of engineering education carried on by the Board of Investigation and Coördination. These reports, sixteen in number, were published in the Journal of Engineering Education from time to time and last year were collected and published as Volume I of the final report.

In 1929–30, R. I. Rees, then President of the Society, made a survey of engineering education, the object of which was to secure a measure of the progress which had been made in engineering education in each institution since the investigation mentioned above. This survey showed a satisfactory growth in students and graduates, a striking increase in graduate work, more attention to educational guidance and orientation of freshmen, a reduction in semester hours required for graduation, and a uniformity of the different courses and schools.

However, one of the most striking facts brought out by this report was the very great increase in graduate work. Of the 110 institutions reporting, 71 had a total enrollment of graduates of 2,835. A study recently completed by the Secretary indicates that the number of graduate students will be materially increased next year.

Thus graduate work has become a more important factor in engineering education. Closely allied to graduate work is technical research. The general topic at this meeting is "Research and Engineering Education." If graduate work is to increase as indicated by this survey, then it seems essential that the amount of research work being done by engineering teachers should also increase.

I was somewhat impressed by a remark made by an industrialist who had studied the report of Dean Seaton's committee, and his conclusion was that there was a very small amount of technical research being done in the engineering colleges of North America. I think every member of this Society will agree that a knowledge of a subject is of primary importance in the teaching of any subject in the engineering curriculum. To many it would seem almost essential that if the teacher is to develop his subject, he must do a certain amount of investigation within that subject and thus obtain first-hand information at least in a small portion of his

field. I believe that most of us feel that such work adds to the zest of teaching, gives life to our courses, and inspires the students in the subject.

It is not proper that this Society should listen to technical papers or have presented at its meetings technical papers which are a result of research. I believe it is the function of the Society to encourage research in engineering colleges as one means for developing teachers and for promoting engineering education.

It is my impression that the amount of research done by different individuals or, perhaps a number of individuals, doing research in engineering colleges is decreasing during the past twenty years. There are, of course, a number of institutions in which research work is thoroughly organized and large and small projects are carried on successfully. However, there is a tendency to differentiate these from the schools of engineering and to differentiate their staffs from the teaching staffs of the colleges.

It would seem that now is the opportune time to lay more stress on this phase of teaching work and it is possible that this Society has a large problem in looking forward to the development of technical research in engineering colleges. I am sure that industry would welcome greater activity on the part of engineering colleges in the field of research especially if it would interest a large percentage of the teachers.

It should be clearly understood that I am not advocating less time to be devoted to the developments which the Society now has under way, but simply to call attention to one factor in the making of a good teacher which this Society seems to have neglected.

Dean R. A. Seaton, Chairman of the Committee on Engineering Research, in his final report, states he "believes it would be highly desirable for all institutions engaged in engineering education to regard engineering research as a normal function of their faculties, valuable both for the results obtained in extending the boundaries of knowledge of fundamental principles and their applications, and for the effects of such research work in developing students and faculty members."

I recommend that the Society, through the Council, appoint a committee on graduate work to make a study of that question.

I also recommend that the Society, through the Council, appoint a committee on research to study the question of developing research in engineering colleges in this country, seeking the cooperation of the National Research Council and other similar bodies, and that the report of Dean Seaton's Committee form the basis upon which such a committee can work.

REPORT OF TREASURER, 1930–31

W. O. WILEY

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
STATEMENT OF CASH ACCOUNT
JUNE 12, 1931

BALANCE ON HAND—JUNE 17, 1930		$ 5,781.25
RECEIPTS:		
Current Dues	$11,128.00	
Back Dues	969.50	
Dues in Advance	247.50	
Sales of Publications	2,025.41	
Advertising	1,844.69	
Interest on Daily Balances	302.19	
Lamme Medal Fund Expenses (Repaid)	235.63	16,752.92
Total		$22,534.17
DISBURSEMENTS:		
Cost of Publications	$ 8,340.85	
Cost of Proceedings	467.22	
Honorarium for Secretary	1,200.00	
Salaries—Secretary's Office	3,300.00	
Traveling Expenses—Secretary's Office	465.04	
Printing, Postage and Office Supplies, etc.	994.93	
Committee Expenses	10.00	
Expenses—Montreal, Canada Meeting, 1930	656.92	
Expenses—Purdue Meeting, 1931	86.34	
Savings Account No. 3809—Forbes National Bank	6,000.00	21,531.30
BALANCE ON HAND—JUNE 12, 1931		$ 1,012.87

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
BALANCE SHEET

JUNE 30, 1931

ASSETS

Cash:		
Current Fund	$ 1,012.87	
Petty Cash Fund	300.00	
Life Membership Fund	674.29	
Benj. G. Lamme Fund	323.09	$ 2,310.25
Savings Account:		
Forbes National Bank—No. 3809		6,000.00
Securities:		
Benj. G. Lamme Fund		5,000.00
Prepaid Expenses—Purdue Meeting, 1931		86.34
Inventory		470.50

Accounts Receivable:		
Current Dues	$ 700.00	
Advertising	377.50	
Interest	92.06	
Lamme Medal Fund	1,000.00	2,169.56
Furniture and Office Equipment (Estimated)		100.00
		$16,136.65

LIABILITIES

Life Membership Fund		$ 674.29
Benj. G. Lamme Fund		5,323.09
Institutional Division:		
Personnel Problems Fund		827.72
Prepaid Membership Dues		247.50
Accounts Payable (Estimated)		1,200.00
Surplus Account:		
Balance—July 1, 1930	$ 6,973.88	
Surplus for this Year	890.17	7,864.05
		$16,136.65

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
INCOME AND EXPENSE ACCOUNT

AT JUNE 12, 1931

For the Year Ending June 30, 1931

EXPENSE

Cost of Bulletins	$ 7,940.85
Cost of Proceedings	467.22
Expenses—Montreal Meeting	1,034.79
Honorarium for Secretary	1,200.00
Salaries—Secretary's Office	3,300.00
Printing, Postage and Office Supplies	1,078.28
Traveling Expenses—Secretary's Office	465.04
Committee Expenses	10.00
Dues—American Council on Education	100.00
	$15,596.18
Surplus for the Year	890.17
	$16,486.35

INCOME

Current Dues	$11,460.00
Back Dues	969.50
Sales of Publications	2,025.41
Advertising	1,637.19
Interest on Daily Balances	394.25
	$16,486.35

A REPORT ON THE SUMMER SCHOOL FOR ENGINEERING TEACHERS *

By H. P. HAMMOND, *Director*

This year marks the completion of five years of the S. P. E. E. Summer School for Engineering Teachers. It seems appropriate, therefore, to present to the Society a report summarizing the work of these five years and to give something of an appraisal of the results accomplished.

Establishment.—When Dr. Wickenden returned from his trip abroad to study methods of engineering education in Europe he brought with him an account of a summer school of brief duration conducted each year by the British Board of Education for teachers of England and Scotland. This was the germ of the idea of our own summer school. We did not pattern our undertaking on the British model; we had, in fact, Dr. Wickenden's general impressions rather than an extended account of the way the school was conducted. I think it is accurate to say that in almost all important respects the S. P. E. E. Summer School is completely an innovation in higher education. It certainly is in this country and so far as I know abroad as well. You may be interested to know that at least two foreign countries (or their representatives) have been sufficiently interested in our undertaking to ask for complete reports on its organization and methods and have expressed the hope that they might institute similar sessions. The countries are Italy and Czechoslovakia.

With Dr. Wickenden's account of the British undertaking before us little time was lost in proceeding to the establishment of our own school. A tentative plan was drawn and submitted first to the Committee on Teaching Personnel which was working with us at the time on problems relating to engineering faculties. Dean Warren of Yale and Professor Kenerson of Brown were chairman and secretary, respectively, of the committee. As I recall, Dr. Howe and other members of the committee gave endorsement to the project, and the committee submitted to the Board of Investigation and Coördination a recommendation looking to the establishment of the school. The Board accepted the recommendation and authorized the establishment of the school for an experimental period of one year as one of the "projects" of the investigation.

* Presented at the 39th annual meeting, S. P. E. E., June 17–19, 1931.

The Board felt, as did the Staff, that some definite steps should be taken as a part of the investigation to aid in the improvement of engineering instruction. The Board's approval, as I remember, was given contingent upon the securing of the necessary funds and the coöperation of institutions at which sessions might be held.

Engineering mechanics was chosen as the subject to be discussed at the sessions of the first year and negotiations were entered into with Cornell University and the University of Wisconsin through Deans Kimball and Turneaure, both members of the Board, in the hope that we might be invited to hold sessions on the teaching of mechanics at those universities. These invitations were extended very cordially and promptly. The Carnegie Corporation of New York provided funds for the first year, and the undertaking was then publicly announced.

It was not until April of 1927 that these preliminary steps were taken and a very short time remained before the date at which we hoped to open the sessions. I remember that there was some uncertainty both in our own minds (Dr. Wickenden's and mine) and in those of the Board as to whether the sessions could be made successful on such short notice. These fears proved to be groundless. We had no difficulty in recruiting the teaching staffs, and the enrolment considerably exceeded our expectations. With the opening of the first session at Cornell on July 6, 1927 and the one at Wisconsin a few days later, the summer school was formally launched.

Sessions of the First Five Years.—By the end of the present summer, nine sessions of the school will have been held and eight divisions of engineering study will have been considered. We have nearly completed the first cycle of the important divisions of engineering education as it has been our aim to do. Thus far no division of the curriculum has been scheduled for more than a single year.

Certain of the figures relating to these sessions are impressive. I think they are given in the following tabulation.

The total attendance by the end of this summer, including both staff and group, will be about 850, or a few more. This is well over one-eighth of all of the engineering teachers of the country. Five hundred ninety, or a few more, of these have been regular attendants, and two hundred eighty staff members. One hundred forty-seven different colleges have been represented in this list. Since there are about one hundred sixty-five such colleges in the United States and Canada you will see what a large proportion of the engineering colleges of North America have been represented at the sessions of the school. You may be interested to know which

Year	Subject	Place	Attendants		Number of Colleges Represented
			Members	Staff	
1927	Mechanics	Cornell University	41	17	36
1927	Mechanics	University of Wisconsin	41	20	32
1928	Physics	Massachusetts Institute of Technology	40	23	36
1928	Electrical Engineering	University of Pittsburgh (with the coöperation of the Westinghouse Electric & Manufacturing Company)	52	45	45
1928	Mechanical Engineering	Purdue University (with the cooperation of the Western Electric Company)	90	49	53
1930	Engineering, Drawing and Descriptive Geometry	Carnegie Institute of Technology	99	20	57
1930	Civil Engineering	Yale University	88	52	60
1931	Chemical	University of Michigan (with the coöperation of the Mellon Institute of Industrial Research)	79	34	
1931	Mathematics	University of Minnesota	60*	19	
			590	279	

* Estimated on the basis of enrolments on May 1, 1931.

colleges have had the largest representations. Purdue and Cornell have each been represented by 14 men; Pennsylvania State and the Kansas State College by 13; Wisconsin by 12; Yale, Brooklyn Polytechnic and the Missouri School of Mines by 11; Worcester, Case, and Carnegie Institute of Technology, by 10 each. Representatives from colleges in Tasmania, Russia, Norway, several provinces of Canada and from every state in the United States have attended the sessions.

Those attending have represented every teaching grade and rank in numbers just about proportionate to the total numbers in those ranks. Those at one of the sessions, for example, have included the following numbers from the various grades of teaching responsibility:

Deans	3
Professors	31
Associate Professors	14
Assistant Professors	13
Instructors	27
Others	2

In the earlier sessions, younger teachers were in the majority. In the later sessions we have had a larger and larger representation of the older and more experienced men, though there are still plenty of the younger men present. I should say that the average of the groups is an assistant professor in his thirties.

The teaching staffs are just as widely representative as the members themselves; 38 different colleges, 35 industrial corporations, 12 foundations and state and federal departments and the offices of 13 consulting engineers have been included. The Massachusetts Institute of Technology and Yale have each been represented on the staff 13 times; Wisconsin 12 times; Harvard 11; Purdue 10; and Cornell and the University of Michigan 9 each. To me, one of the most remarkable things about the summer school is the quality of the teaching staffs we have been able to assemble. With very few exceptions indeed, those invited to serve have done so; and they have done so willingly and cheerfully, in many instances at great sacrifice of time and convenience. Staff members have come from all parts of the country; several having made the trip from the Pacific coast for the purpose. The staff of one of the sessions, civil engineering for example, has read almost like a "Who's Who in the Profession." If the success of the school can be said to be due to any one factor more than any other, I think it has been the able staffs of lecturers that have served.

In this matter of the staffs I want to take this opportunity to pay my respects to the local directors and secretaries who have conducted the sessions. A good many factors have entered into the selection of the various institutions at which sessions have been held.

Programs.—There has been something of an evolution in the programs of the sessions. Those of the first year were comparatively simple and the staffs small. As the work has gone on, the sessions have become much more elaborate and the staffs very much larger. The session on mechanical engineering, held here at Purdue, marked the greatest departure from the early sessions. Mechanical engineering being a comprehensive division of the curriculum, we departed from the type of program which had been provided previously in which all of the members attended all of the meetings, and planned instead a program of two rather dissimilar parts. In the first part all members of the session attended all of the meetings which were devoted to general educational principles, the history of mechanical engineering and a number of other topics of interest and importance to all teachers of mechanical engineering. The second part was divided into three parallel divisions, for teachers of heat power, machine design, and produc-

tion respectively. Meetings of these divisions were held simultaneously and were devoted principally to discussion of specific teaching problems.

Certain elements have been common to all of the sessions and I give you below an outline of one of the programs as an indication of the general arrangement of the scheme which underlies it:

I. General methods of teaching
   - Laws of learning
   - Principles of teaching
   - Problems of student personnel
   - Teaching procedures
   - Examinations and tests

II. Methods of teaching physics
   - As related to divisions of the subject: mechanics, heat, sound, etc.
   - As related to kinds of class exercises: lectures, recitations, laboratory periods, etc.

III. Coördination of the subject with other divisions of the curriculum.
   - Subjects preparatory to physics
   - Subjects for which physics is prerequisite
   - Subjects runnings concurrently

IV. History of physics

V. Advanced phases and applications of physics in engineering

VI. Lectures on topics of general interest, recreation, etc.

Time does not permit of any fuller discussion of this phase of the Summer School and I can merely say that as time goes on, we shall doubtless continue to modify the details of the program to accord with the nature of the subject under discussion.

We have done quite a little experimenting with different types of exercises. Formal lectures, general discussions, seminars, laboratory inspections, demonstrations, model teaching exercises, and one or two other types of meetings have been held. The formal lecture has always been and continues to be the chief medium of instruction at the sessions. Second in importance have been the general discussion periods which have followed the lectures. Visits of inspection to shops, laboratories, and industrial establishments have constituted the third most important element in the programs. We have had varying success with the other types of meetings. I must confess that the model teaching exercises, which we hoped would be the means of critical appraisal of teaching methods, have

not proved successful. The effort to reproduce the atmosphere of the undergraduate classroom with a group of mature teachers, so as to illustrate methods of conducting an actual class, have failed, and we have abandoned this type of meeting. We are also putting less emphasis on the small seminar group meeting, and are devoting the time so released to general discussions. We have learned that the out-of-hours informal conferences or bull sessions, as they have been called, when the men exchange information and ideas freely and informally, have taken the place of the less formal parts of the program itself. I may pause here long enough to say that these purely informal features of the sessions have undoubtedly been among their most valuable characteristics. I think if the sessions did not accomplish anything else than the promotion of friendships, and the free exchange of ideas, and the building up of an esprit de corps among the teachers of a given subject, they would have fully justified all of the expenditure of time and effort that has gone into it.

Recreation and Social Features.—We have always made a definite effort, since the beginning of the Summer School, to promote a spirit of friendliness and to give everybody, both members of the group and of the staff, an opportunity to become acquainted. This has been done in the first place by having all of the members and the staff live together for the period of the session in one of the dormitories of the institution at which the session is held. I may say that we have had most excellent housing facilities. We have also provided for sports and amusements to occupy what little spare time there has been. I should like to have time to describe some of these informal activities, but it is difficult to give any idea of the spirit with which the men have entered into all of the phases of the school. Those of you who have been, for example, at the closing dinners, or who have been at the Yale Surveying Camp, or on the campus at Cornell, or who have lived at the Carnegie Institute of Technology, or who have, in fact, attended any of the sessions, understand why I cannot in words reproduce the environment or the spirit of the meetings.

Publications.—We have in our office in New York a very complete record of all the proceedings of the sessions. These records include the original manuscripts and a digest of all the discussions, as well as the reports of committees, and an account of all of the other activities. These proceedings have been compiled in each instance by a committee of the members of the session acting as a group of reporters. Each member who volunteered has been assigned to one or more of the periods of the school and it has been his responsibility to secure the manuscript or to write a digest of

the lecture and to prepare an account of the more important points in the discussions. From these records we have abstracted certain selected papers and reports, which have been published in the JOURNAL and as separate monographs. There are now seventeen numbers in this series of bulletins, in addition to the publication of the first year, which was Bulletin No. 14 of the general investigation. The subjects of these bulletins have as a rule fallen in three or four principal classes of topics:

1. Papers on educational principles,
2. Papers on the history of the subject,
3. Papers on methods of teaching particular subjects of instruction,
4. Papers of technical aspects of engineering practice.

Various scientific and technical periodicals, including the publications of the American Society of Mechanical Engineering and the American Society of Civil Engineers, have published a number of articles drawn from the Summer School material. All of these publications may be procured from the Lancaster Press at a nominal charge.

RESULTS.—The speaker does not feel that he ought to attempt to evaluate the Summer School, since he is probably somewhat prejudiced in its favor. Instead, the following quotation from an article which appeared in *Mechanical Engineering* may be taken to indicate reasonably well the general view of those who attended and their estimate of the results accomplished.

WHAT DID THE SUMMER SCHOOL ACCOMPLISH?

"To evaluate adequately the benefits attributable to the summer school at Purdue is to attempt to give substance to a host of intangibles. Like the process of education, the experience will weigh differently with different men. It was a golden opportunity for the young instructor to absorb in countless ways a realization of the significance and importance of his profession and to benefit by numerous very definite additions to his knowledge of the subject matter he is teaching. He went away with an improved technique derived from specific suggestions made by the lecturers and by his observations of them and their methods. He saw the subjects he had been teaching presented in a new light. He heard problems discussed, the significance of which had never before appealed to him, and an enthusiasm to tackle them himself fired his ambitions. He met and talked with men whom he had read about, whose books he had studied, whose names had been heroic to him.

"The narrowness of sectionalism was dissipated in this meeting of men from all over the United States. The problems of teaching

are largely similar, although local conditions may give them a different cast. And the local problems that arise in different social groups and sometimes affect major policies are more sympathetically understood after living three weeks with men representing so many of these groups.

"The schools to which these men return will benefit in more ways than one. The man comes back a better teacher, a broader individual. His outlook upon the problems of his school is more mature and less provincial. Fortunate indeed is engineering education in general which can number among its teachers so many who have benefited from the experience of the summer school, and fortunate the college whose faculty contains several men so trained. An institution honestly trying to improve its methods and product will find that the slight expense involved in sending its instructors to one of these schools will be wonderfully fruitful. And yet, in spite of the obvious advantages to the school, more than half of the men who attended received no financial assistance from their institutions.

"The engineering societies are also beneficiaries in this program. To them falls the responsibility of fostering and giving direction to the efforts of engineers to help their profession. The profession is changing. Older men retire, or die, but younger men take their places in greater numbers. Most of these men come from the colleges. It is to the advantage of engineering societies, as it is to society at large, that these young men be of the highest type and have the best training that can be given. Their outlook upon life must be broad and sympathetic. They have it in their power to advance or to retard the progress of the industrial age—to brighten its luster or to bring it into discredit. Jealous of the record its members have made, the engineering societies have a very definite stake in the progress of engineering education. They could wish that all engineering teachers might be men to inspire the best and noblest ambitions and the broadest outlook upon life in the young men whom they teach.

"The stimulating experiences to which 89 deans, professors, and instructors of mechanical engineering were subjected at the S. P. E. E. Summer School for Engineering Teachers held at Purdue University from June 27 to July 18, 1929, are bound to have permanent and beneficial effects upon them and their profession. For three weeks the members of the summer school lived and ate under the same roof and sat together in the classroom listening to lectures and taking part in discussions on the aims, content and methods of teaching the subjects which comprise the mechanical engineering curriculum. They represented 60 educational insti-

tutions and come from 36 states and two of the Canadian provinces. As a cross-section of the profession of engineering teaching they made as typical a group as could have been brought together. The open-minded, earnest, and intelligent attention which they gave to making the most of an exceptional opportunity leads to the conviction that the return on any investment which they, their institutions, or the sponsors and staff of the school may have made will be a handsome one.

"Lectures and discussions made up the day's work at Purdue. A staff of lecturers, qualified by their exceptional attainments as educators and engineers, had been recruited from engineering colleges and the industries. The program was so rich in valuable material carefully planned to fit into a preconceived scheme that every morning and afternoon, and many evenings, were devoted to lectures, discussions, and committee meetings.

"Because mechanical engineering is a broad and inclusive field, it was decided to divide a portion of the program into three parts so that special emphasis could be placed upon three major branches of engineering subjects: heat power, machine design, and production. This plan provided smaller groups for the discussion of some of the more specific problems in these fields by men especially interested in teaching these subjects. The more general lectures and discussions were attended by all. The only disadvantage to the plan was that some very excellent lectures were given simultaneously, to the distress of those who wished to hear two or more speakers at the same hour. To have adopted a plan whereby every one might have heard every lecture, however, would have extended the length of the course unwisely.

Some Impressions

"The impressions which are made by such an experience as this one at Purdue will vary with the individual and are not always easy to transmit. The present reviewer, therefore, records some of his own interpretations of the more general themes which dominated, in his mind, the spirit of the papers and discussions.

"There was, first of all, a reassuring conviction that teachers of engineering are on the right track. In an age of sudden changes and in a new environment, both attributable in a large degree to the impress of the engineer upon civilization, methods and purposes of education have undergone change also. While some have failed to recognize this fact, while others have been stampeded into ill-advised programs of specialty training, engineering teachers have been able to maintain a conservative balance with a progressive

vision. What is more significant, they have, and in this they are unique, boldly questioned their aims, ideals, and methods, with a hope, which has been realized in part at least, of improving themselves, their schools, and their product. No other group of teachers, it may be confidently said, has done this in as thorough a manner, and no other group of teachers has formulated so definitely its ideas in these essential points. Colleges of liberal arts, offering varied programs of studies, have never given such strict attention to the result they hope to accomplish or the means by which it is to be accomplished, because their objectives lack the definiteness which gives form to the engineering curriculum and the educational needs of the graduate engineer."

* * * * * * *

Like Professor Scott's conception of the investigation of engineering education from which the summer schools sprang, this undertaking has been essentially a coöperative one. The number of individuals and of institutions mentioned previously in this paper that have contributed to it are only part of the number that might be mentioned. In the five years of the school we have had the coöperation and support of several of the Society's Committees —those on Engineering Drawing and Descriptive Geometry, on Civil Engineering, and on Mathematics, for example. We have had the endorsement and support of five national professional societies: The American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Chemical Engineers, the American Mathematical Society and the Mathematical Association of America. Two of these societies, The A. S. M. E. and A. S. C. E., have been generous contributors of funds. Several industrial firms have contributed funds and facilities to the work; others have sent members of their engineering staffs as lecturers. The General Electric Company, Westinghouse Electric and Manufacturing Company and the Western Electric Company have given funds for particular sessions. Three foundations have given support and financial assistance: The Carnegie Corporation of New York, Chemical Foundation and Engineering Foundation. The Highway Education Board and the Portland Cement Association have contributed funds. As mentioned previously nine universities and colleges have been our hosts and six of these—Massachusetts Institute of Technology, Carnegie Institute of Technology, Purdue University, Yale University, the University of Michigan and the University of Minnesota have contributed funds toward sessions held on their campuses. (I might say here that the only reason why the others at which sessions have been held have not also

contributed is the fact that we did not request them to do so.) And finally, not less than 50 colleges have paid either all or a substantial part of the expenses of members of their faculties who have attended.

It is in order, I think, thus publicly to express appreciation for the interest and the generosity of all of these institutions, foundations, firms, and individuals who have given their support and encouragement to this phase of the society's activities. I believe it is an indication of a general belief in the fundamental importance of engineering education.

A STUDY OF ENGINEERING ENROLLMENTS

By WALTON C. JOHN

Associate Specialist in Graduate and Professional Education, Office of Education, United States Department of the Interior

The schools of engineering in the United States enrolled 78,685 students in 1930–31. Of these, 73,386 were undergraduate students, 2,939 were graduate students, and 2,360 were classified as special students. These figures are for 145 institutions giving engineering courses and related types of training of college grade. At the close of the school year 1929–30, 149 schools of engineering were listed in this country. Four of these have been dropped from the list, two because they have been discontinued, and two because of improper classification.

A comparison of engineering enrollments over a period of six years is given in the following table:

TABLE I

Comparison of Total Enrollments in Engineering Shcools

Year	Number of Institutions	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....	143	56,299	54,337	1,114	848
1926–27.....	148	62,312	59,853	1,566	893
1927–28.....	148	65,520	63,023	1,669	828
1930–31.....	145	78,685	73,386	2,939	2,360

As no inquiry was made in 1928–29, the figures for that year cannot be given. The figures collected in 1929–30 as given in the Report of the 1930 Survey of Engineering Education, show an enrollment of 58,853 in 119 schools with 70,000 estimated for 145 schools.

A comparison of the enrollments of 1925–26 and 1930–31 may be made notwithstanding the failure of a few small schools to report, as the difference in total enrollments would be negligible.

On this basis we find an increase of 22,386 students between 1925–26 and 1930–31, or approximately 40 per cent.

The increase of four-year undergraduate engineering students is 19,049, or 35 per cent for the same period.

The increase in the number of graduate students is 1,825, or 164 per cent. The increase in the number of special students is 1,512 or 178 per cent.

Attention is given in the following tables to the enrollments in the major fields of specialization.

TABLE 2

CIVIL ENGINEERING

Year	Number of Institutions	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....	143	12,502	12,170	156	176
1926–27.....	148	13,633	13,296	240	97
1927–28.....	148	14,073	13,683	266	124
1930–31.....	145	14,534	13,813	333	388

The increase in total enrollments in civil engineering during five years is 2,032, or 16 per cent; the increase in four-year undergraduate students is 1,643, or 13 per cent; the increase in graduate students is 177, or 113 per cent; and the increase in special students is 212, or 120 per cent.

TABLE 3

MECHANICAL ENGINEERING

Year	Number of Institutions	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....	143	10,642	10,337	156	149
1926–27.....	148	10,171	9,891	206	74
1927–28.....	148	11,273	10,949	240	84
1930–31.....	145	15,684	15,053	343	288

The increase in total enrollments in mechanical engineering during five years is 5,042, or 47 per cent; the increase in four-year undergraduate students is 4,716, or 46 per cent; the increase of graduate students is 187, or 120 per cent; and the increase in special students is 139, or 93 per cent.

It will be noted that the sharp increase in enrollments in mechanical engineering has taken place since 1927–28.

TABLE 4

ELECTRICAL ENGINEERING

Year	Number of Institutions	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....	143	18,161	17,720	281	160
1926–27.....	148	20,215	19,622	434	159
1927–28.....	148	20,210	19,617	468	125
1930–31.....	145	19,992	18,565	790	637

The increase in total enrollments in electrical engineering during five years is 1,831, or 10 per cent; the increase in four-year undergraduate students is 845, or five per cent; the increase in graduate students is 509, or 181 per cent; and the increase in special students is 477, or 298 per cent.

Attention is called to the slight decrease in undergraduate and total enrollments in electrical engineering between 1927–28 and 1930–31.

TABLE 5

CHEMICAL ENGINEERING

Year	Number of Institutions[1]	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....		4,897	4,627	214	56
1926–27.....		5,754	5,487	237	30
1927–28.....		5,987	5,702	272	13
1930–31.....	109	9,667	9,154	400	113

[1] Owing to lack of data, the number of institutions offering chemical engineering is not given for the years 1925–26 to 1927–28.

The increase in total enrollments in chemical engineering during five years is 4,770, or 97 per cent; the increase in four-year undergraduate students is 4,527, or 98 per cent; the increase in graduate students is 186, or 87 per cent; and the increase in special students is 57, or 102 per cent. Attention is called to the sharp increase in enrollments in chemical engineering since 1927–28.

The increase in total enrollments in mining engineering and metallurgy during five years is 874, or 42 per cent; the increase in four-year undergraduate students is 880, or 47 per cent; the in-

TABLE 6

MINING ENGINEERING AND METALLURGY

Year	Number of Institutions[2]	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....		2,070	1,891	98	81
1926–27.....		2,018	1,856	92	70
1927–28.....		2,143	1,942	94	107
1930–31.....	42	2,944	2,771	129	44

[2] Owing to lack of data, the number of institutions offering mining engineering and metallurgy is not given for the years 1925–26 to 1927–28.

crease in graduate students is 31, or 32 per cent; however, there is a decrease in special students to the extent of 37, or 46 per cent.

It will be observed that the principal increase in enrollments in mining engineering and metallurgy has been since 1927–28.

TABLE 7

ARCHITECTURAL ENGINEERING

Year	Number of Institutions[3]	Grand Total Enrollments	Total 4-year Undergraduates	Total Graduate Students	Special Students
1	2	3	4	5	6
1925–26.....		2,529	2,444	19	66
1926–27.....		3,051	2,979	38	34
1927–28.....		3,256	3,172	45	39
1930–31.....	38	2,940	2,840	42	58

[3] Owing to lack of data, the number of institutions offering architectural engineering is not given for the years 1925–26 to 1927–28.

The increase in total enrollments in architectural engineering during five years is 411, or 16 per cent; the increase in four-year undergraduate students is 396, or 16 per cent; the increase in graduate students is 23, or 121 per cent. There has been considerable decrease in the number of special students in architectural engineering during the past five years.

A slight decline will be noted in the enrollments in this field since 1927–28 with the exception of special students.

Distribution of Engineering Students by Classes

The following table shows the number and percentage of engineering students by classes for the years indicated.

The foregoing figures show a remarkable constancy in the proportion of students in the several classes over the six-year period. Also, we may compare the freshman enrollments for 1926–27 with those of the senior class for 1930–31. This indicates that the number enrolled in the senior class is 53.4 per cent of the number enrolled in the original freshman class.

There appears to be a large mortality before the senior year, approximately 46.6 per cent. This figure is, of course, influenced by the fact that many students do not attend college continuously for the four years required, and by the fact that during the period under discussion, there has been marked increase in total enrollments.

Distribution of Engineering Enrollments According to Curricula or Specific Courses

The following table summarizes the enrollments in all of the major fields of specialization as well as in particular courses of engineering study.

The grand total figures are indicated in descending order; this is likewise true with a few exceptions for the total enrollments of undergraduate students.

For the year 1930–31, the order of rank according to the number of students enrolled in excess of 2,000 in the major fields of specialization is as follows: Electrical engineering, mechanical engineering, civil engineering, chemical engineering, mining and metallurgy, architectural engineering, and aeronautical engineering.

Attention is called to the rapid growth of aeronautical engineering in recent years. In 1925–26, only 122 were enrolled. Of these, 98 were undergraduate students, 23 were graduate students, and one was a special student. In 1927–28, 614 were enrolled. Of these, 574 were undergraduate students, 33 were graduate students, and seven were special students. In 1930–31, there were 2,057 enrolled, of whom 2,003 were undergraduate students, 45 were graduate students, and nine were special students.

TABLE 8

DISTRIBUTION OF FOUR-YEAR UNDERGRADUATES IN ENGINEERING BY CLASSES

Year	Number of Institutions	Total Undergraduate Enrollment	Per Cent	Classes							
				Freshmen		Sophomore		Junior		Senior	
				No.	%	No.	%	No.	%	No.	%
1	2	3	4	5	6	7	8	9	10	11	12
1925–26	143	54,337	100	20,063	36.9	14,493	26.7	10,695	19.7	9,063	16.7
1926–27	148	59,853	100	22,765	38.0	16,123	27.0	11,562	19.3	9,403	15.7
1927–28	148	63,023	100	23,360	37.1	16,905	26.8	12,685	20.1	10,073	16.0
1930–31	145	73,386	100	25,332	34.5	19,631	26.7	16,262	22.7	12,161	16.6

TABLE 9

SUMMARY OF ENROLLMENTS IN 145 ENGINEERING SCHOOLS IN THE UNITED STATES IN 1930–31

Curricula and Courses	Freshmen	Sophomore	Junior	Senior	Total Undergraduate	Graduate	Others	Grand Total
1	2	3	4	5	6	7	8	9
Electrical	6,662	4,768	3,973	3,162	18,565	970	637	19,992
Mechanical	5,322	4,217	3,287	2,227	15,053	343	288	15,684
Civil	4,452	3,563	3,154	2,644	13,813	333	388	14,534
Chemical	3,433	2,567	1,877	1,277	9,154	400	113	9,667
Mining and metallurgy	940	712	647	472	2,771	129	44	2,944
Architectural	821	820	657	542	2,840	42	58	2,940
Aeronautical	695	591	462	255	2,003	45	9	2,057
General	521	252	473	172	1,418	16	3	1,437
Chemistry	272	201	179	143	795	384	167	1,346
Architecture	335	286	268	249	1,138	47	7	1,192
Industrial	278	375	263	233	1,149	8	5	1,162
Business and administrative	279	253	161	144	837	8	1	846
Petroleum	218	192	153	81	644	44	3	691
Ceramics and ceramic engineering	177	163	109	108	557	37	33	627
Textile	119	69	70	37	295	1	34	330
Physics and engineering physics	83	94	73	50	300	19	1	320
Geology and geological engineering	109	72	67	42	290	22	2	314
Agricultural	102	75	60	40	277	19	0	296
Mechanic arts	112	27	26	38	203	30	—	233
Production	83	72	26	2	183	0	0	183
Building construction	22	27	27	30	106	0	0	106
Biology and public health	13	16	21	28	78	21	0	99

TABLE 9—(*Continued*)

Curricula and Courses	Freshmen	Sophomore	Junior	Senior	Total Undergraduate	Graduate	Others	Grand Total
1	2	3	4	5	6	7	8	9
Oil and gas	22	19	23	16	80	19	0	99
Fire protection	21	28	21	27	97	0	0	97
General science	17	20	28	24	89	7	1	97
Industrial arts	25	22	14	19	80	8	4	92
Naval architecture and marine engineering	23	23	29	10	85	2	0	87
Electrochemical	31	20	15	12	78	2	0	80
Navy post graduate	0	0	0	0	0	38	0	38
Ship operation	7	3	6	6	22	0	0	22
Railroad operation	1	4	4	7	16	3	0	19
Railway electrical	5	4	4	4	17	0	0	17
Interior architecture	0	0	7	8	15	0	0	15
Naval construction	0	0	0	7	7	8	0	15
Sugar engineering	3	1	3	5	12	0	0	12
Fuel engineering	3	3	6	0	12	0	0	12
Army ordnance	0	0	0	11	11	0	0	11
Landscape architecture	6	5	0	0	11	0	0	11
Railway civil	1	2	3	4	10	1	0	11
Railway mechanical	0	2	1	1	4	5	0	9
Flour mill engineering	2	1	1	2	6	1	0	7
Special and unclassified	117	62	64	22	265	107	562	934
Total	25,332	19,631	16,262	12,161	73,386	2,939	2,360	78,685

Enrollments in Engineering Schools by Institutions

The following table gives the enrollments in each of the 145 engineering schools.

Analysis of this table shows that five engineering schools have enrollments of 2,000 or more. Eight have enrollments ranging from 1,500 to 2,000; six have enrollments ranging from 1,001 to 1,500; thirty-one have enrollments ranging from 501 to 1,000; and 95 have enrollments of less than 500. Of the latter group 16 have enrollments of less than 100 engineering students.

TABLE 10

Enrollments in 145 Engineering Schools.[1] By Institutions for the Years 1930–31

Institution 1	Total Four-year Undergraduate Enrollment 2	Total Enrollment Including Graduate and Other Students 3
Alabama Polytechnic Institute	839	869
University of Alabama	554	562
University of Arizona	230	252
University of Arkansas	244	244
University of Santa Clara	107	107
University of Southern California	283	310
Stanford University	430	505
University of California	1,617	1,796
California Institute of Technology	227	273
Colorado College	65	69
University of Colorado	679	679
Colorado Agricultural College	337	337
University of Denver	158	161
Colorado School of Mines	586	500
Yale University	347	406
Connecticut Agricultural College	63	63
University of Delaware	185	188
George Washington University	444	444
Howard University	30	30
Catholic University of America	133	142
John B. Stetson University	19	19
University of Florida	269	283
University of Georgia	59	59
North Georgia Agricultural College	18	18
Georgia School of Technology	1 509	1,556
University of Idaho	254	257
Armour Institute of Technology	801	809
Lewis Institute	328	328
Northwestern University	265	278
University of Illinois	2,091	2,345
University of Notre Dame	431	431
Valparaiso University	85	85
Evansville College	46	46

[1] These figures represent the total attendance of these schools, although in several cases the enrollments include students in courses which are not strictly engineering, such as architecture, physics, chemistry, etc.

TABLE 10—(*Continued*)

Institution 1	Total Four-year Undergraduate Enrollment 2	Total Enrollment Including Graduate and Other Students 3
Tri-State College	124	124
Purdue University	2,536	2,777
Rose Polytechnic Institute	287	287
State University of Iowa	385	401
Iowa State College of Agriculture and Mechanic Arts	1,487	1,550
University of Kansas	606	615
Kansas State Agricultural College	1,028	1,061
University of Kentucky	539	553
University of Louisville	142	144
Tulane University of Louisiana	267	271
Louisiana State University and A. & M. College	514	522
University of Maine	535	548
Johns Hopkins University	337	365
University of Maryland	322	322
Massachusetts Institute of Technology	2,614	3,209
Worcester Polytechnic Institute	611	627
Northeastern University	1,658	1,658
Tufts College	314	314
Lowell Textile School	51	51
Harvard University	190	274
University of Detroit	1,138	1,140
University of Michigan	1,651	1,798
Michigan State College	374	381
Michigan College of Mining and Technology	487	487
University of Minnesota	1,937	2,003
University of Mississippi	64	64
Mississippi A. & M. College	539	539
Washington University	392	401
University of Missouri	365	366
Missouri School of Mines and Technology	501	548
Montana State College	396	397
Montana School of Mines	166	176
University of Nebraska	773	792
University of Nevada	184	206
University of New Hampshire	378	378
Dartmouth College	7	21
Stevens Institute of Technology	453	469
Princeton University	206	220
Rutgers University	224	227
Newark College of Engineering	383	383
New Mexico College of A. & M. Arts.	171	175
New Mexico School of Mines	110	110
State University of New Mexico	133	133
Polytechnic Institute of Brooklyn	498 [2]	2,459 [3]

[2] Day students.

[3] 1,701 of these are in the evening session.

TABLE 10—(*Continued*)

Institution 1	Total Four-year Undergraduate Enrollment 2	Total Enrollment Including Graduate and Other Students 3
Clarkson College of Technology	373	376
Cooper Union Institute of Technology	266	266
Rensselaer Polytechnic Institute	1,714	1,747
Columbia University	369	510
New York University	766	785
College of the City of New York	546	578
Syracuse University	351	354
Manhattan College	168	174
Union University	117	282
Cornell University	1,172	1,225
University of Rochester	103	103
Alfred University	114	115
Duke University	101	101
University of North Carolina	270	277
North Carolina State College of Agriculture and Engineering	685	703
University of North Dakota	188	222
North Dakota Agricultural College	333	333
Case School of Applied Science	739	751
University of Dayton	158	158
Ohio Northern University	209	211
Antioch College	53	56
Ohio State University	1,624	1,674
University of Akron	241	241
University of Cincinnati	1,278	1,278
University of Oklahoma	879	916
Oklahoma A. & M. College	726	760
Oregon State College	797	806
Bucknell University	198	200
Carnegie Institute of Technology	862	927
Drexel Institute	913	913
Gettysburg College	65	65
Lafayette College	283	283
Lehigh University	866	914
Pennsylvania Military College	18	18
Pennsylvania State College	1,359	1,379
Swarthmore College	56	56
University of Pennsylvania	294	372
University of Pittsburgh	661	993
Villanova College	201	201
Brown University	146	150
Rhode Island State College	253	253
Clemson Agricultural College	541	541
The Citadel, the Military College of South Carolina	154	154
University of South Carolina	210	213
University of South Dakota	112	112
South Dakota State College of A. & M. Arts	260	262
South Dakota School of Mines	384	387

TABLE 10—(*Continued*)

Institution 1	Total Four-year Undergraduate Enrollment 2	Total Enrollment Including Graduate and Other Students 3
Vanderbilt University	177	177
University of Tennessee	525	538
Rice Institute	356	359
A. & M. College of Texas	1,480	1,506
University of Texas	653	667
College of Mines and Metallurgy, El Paso, Texas	168	169
Texas Technological College	399	399
University of Utah	380	380
Agricultural College of Utah	136	160
University of Vermont	134	134
Norwich University	162	162
Washington and Lee University	51	51
University of Virginia	152	156
Virginia Polytechnic Institute	864	895
Virginia Military Institute	562	562
University of Washington	892	906
State College of Washington	495	498
West Virginia University	320	331
University of Wisconsin	1,059	1,068
Marquette University	459	459
University of Wyoming	165	165

THE PLACEMENT OF JUNE 1931 ENGINEERING GRADUATES

Several members of the Society requested that information concerning the placement of this year's graduates from the Engineering Colleges be secured and placed before the members at the Annual Meeting.

Under the date of May 28 the Secretary sent a letter to 121 institutions asking for the total number of graduates in the several divisions and the number in each division placed.

The following table gives the summary for replies received from 88 institutions of which 10 had no information concerning the placement of their graduates. The table below does not include these 10.

Divisions	Graduates	Graduates Placed	Per cent Graduates Placed
Chemical	650	301	46.3
Civil	1310	489	37.5
Electrical	1609	537	33.4
Industrial	249	110	44.2
Mechanical	1202	493	41.0
Mining	206	93	45.1
All Others	640	217	34.0
Total	5866	2240	38.2

The total number of graduates in 88 institutions reporting was 7184.

The figures show that the institutions west of the Mississippi had placed about 3% more than those east.

There is no difference between the large and small institutions or between cooperative and non-cooperative colleges.

The same statement holds for state vs. endowed colleges.

The colleges in urban centers have placed about 5% less of their graduates.

In previous years, all graduates were placed at time of graduation.

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

The Purdue meeting of the Division of Engineering Drawing was made memorable by a number of outstanding papers. President William E. Wickenden's suggestions for broadening the scope of service of Engineering Drawing departments may perhaps set an ideal towards which many departments will strive; "The Field of Graphic Arts" by Professor Thomas E. French, "The Artistic Side of Engineering Design" by Donald R. Dohner, Director of Art for the Westinghouse Electric and Mfg. Co., "Art in Engineering Structures" by Professor Newlin D. Morgan not only emphasized the importance of beauty in engineering design but were interesting illustrations of how authors, working independently, often develop an idea along similar lines, thus reinforcing and strengthening each other's contribution. The Conference on Drawing concluded with a "Survey of Activities of Engineering Drawing Departments" by Professor C. L. Svensen, and two more papers by Professor J. Rexford Newcomb and Professor F. M. Porter, further developing the need for and manner of achieving beauty in engineering design.

As a direct result of these papers, the editor has collected and will publish from time to time references to books and articles which teachers of engineering drawing may read with profit. The following titles have been submitted by Newlin D. Morgan, Associate Professor of Architectural Engineering, University of Illinois:

"The New World Architecture"—Sheldon Cheney. Longman, Green and Co., 1930, $10.00. A scholarly survey of the contribution of the engineer in modern architecture and the trend of recent architectural developments.

"Ideals of Engineering Architecture"—Fowler, C. E., Gillette Publishing Co., Chicago, 1929, $4.00. The author is a prominent American engineer who has taken a life-time interest in the application of art to engineering design. Treats of various types of engineering structures.

"Beautiful Necessity"—Bragdon, Claude, The Manas Press, Rochester, New York, 1910. Many will find interesting food for thought in this unique treatise on theosophy and the philosophy of art, geometry, and music.

"Toward a New Architecture"—Le Corbusier, Payson and Clarke, New York. The trend of modern structural problems and the relations of the engineer and architect as seen by a prominent French architect. Interesting; pointed; staccatto in style.

MACHINE DESIGN CLEARING HOUSE

A recent discussion topic was "The Correlation of Experimental Laboratory Projects with Courses in Machine Design." Abstracts from the leading discussion and from several comments follow:

"Experimental projects assigned to undergraduates in the mechanical engineering laboratories deal almost exclusively with heat engines and hydraulic machinery. It seems to me that more of the laboratory experiments should deal with machine elements—to verify formulas derived in the class room as well as to study the characteristics of mechanisms. Machine design would become a more interesting and valuable subject to the student. Among such tests would be included:

1. Slip of leather and rubber belts at various speeds and under various amounts of initial tension. Power transmitted at different speeds. Stresses in belts, also power lost, due to bending over small pulleys. Variation of coefficient of friction with speed.
2. Torsion dynamometer.
3. Efficiency of several types of chain hoists under a range of loads.
4. Efficiency of screws for power transmission. Efficiency versus angle of thread. Tests of screw jacks.
5. Efficiency of roller chain drives at different speeds; also for link belts.
6. Experiments in connection with lubrication.
7. Radiation and wear tests of bearings.
8. Tests of ball and roller bearings.
9. Tests of friction clutches.
10. Tests of brakes of various types and materials.
11. Tests of springs to verify deflection formulas.
12. Tests of flywheels for speed regulation.
13. Tests of speed governors.
14. Tests of linkages, epicyclic gearing and other mechanisms."

You have started a discussion on a subject which is of vital importance to a proper grasp of machine design. In conjunction with our Thermodynamic Laboratory we have our third year students carry out some mechanical experiments such as belt testing,

screw thread testing, and flywheel calculations. The experiments in your list would certainly provide an excellent range and I hope that we shall be able to incorporate at least some of them in our course here in the next few years."

"Your suggestion relative to the correlation of experimental laboratory projects with the courses in Machine Design is timely. I am quite sure that a proper adjustment between the design problem and the experimental investigation, relative to the problem, would add much of interest and value to the course in Machine Design. If a correlation of laboratory and design can be worked out, I believe that it would give to our Machine Design courses the so-called practical value which is, in the main, at present lacking."

"The writer is fully in accord with the view that more of the projects in mechanical engineering laboratories should deal with machine elements. In our own laboratories we already cover fairly well the list of suggested experimental projects given in your bulletin. We have, for example, either in use or in preparation, tests on slip of belts, efficiency of power screws, lubricants, radiation and wear of bearings, friction clutches, brakes, and linkages. In addition, we have for regular undergraduate work a drill dynamometer equipped for recording thrust and torque in the operation of twist drills, and a lathe dynamometer equipped for recording pressure on the tool, force required to hold tool to work, and force required to feed the tool. We are of the opinion that these experimental projects are useful in giving the student an early appreciation of the importance of the fundamental theory taught in the Machine Design course.

"As another project that might be added to the original list, static and dynamic balancing is suggested. The elimination of vibration and noise has become a very important factor in Machine Design."

"It has long been my feeling that this side of instructional laboratory work should be given a development commensurate with the side of power production. My plan of a complete laboratory includes a division devoted to this kind of work, covering the items listed, with extension into vibration and balancing. In part the equipment would be for demonstration, in part for routine student use. So far this is no more than a plan; restrictions of space and funds have kept our laboratory equipment and work mostly in the field of heat engines, pumps, etc."

"Experimental laboratory courses are generally conducted with the double purpose of teaching the student how to lay out and run experimental tests and to illustrate the characteristics of operation of certain types of machinery.

"I feel that laboratory work can be used to great advantage in assisting in the teaching of Machine Design but I believe it should be entirely separated from the regular mechanical laboratory courses. In a machine design laboratory the emphasis should be laid upon the illustration of certain principles and the tests should take the form of demonstrations rather than research experiments. Among such tests might be included:

(*a*) Tests on vibration, including torsional, and the effect upon the period by change of dimensions and weights.
(*b*) Tests on speed governors.
(*c*) Tests on flywheels for speed regulation and variation produced in their angular velocity.
(*d*) Resolution of forces in linkages, pulleys, inclined planes (including screw threads).
(*e*) Gyroscopic action."

"It seems to be a fact that in most mechanical engineering departments the professor in charge is a power plant man, and this may explain to some extent the large amount of power plant tests in the usual laboratory course. A few schools do attempt some work along the lines which you mention but this type of laboratory testing is a very minor part of the work.

"No very large proportion of the mechanical engineering graduates actually become designers, but a large majority do come directly in contact with design problems in sales, purchasing, operating or production. It is therefore rather important that laboratory work should include projects relating to Machine Design as well as projects relating to power generation.

"The list of experiments in your list is good. The item on lubrication might be extended to include specifically clearance effects, temperature effects, rubbing speed effects, and viscosity effects.

"Other projects which might be included are:

(*a*) Tests on gearing, such as tests of spur, helical, bevel and worm gearing to determine friction, radial pressures, thrust pressures and if possible some determination of stress.
(*b*) Critical speeds on shafts with different types of loading.
(*c*) Determination and strength of riveted and welded joints.
(*d*) Determination of stress and deformation in curved beams.

(*e*) Studies on the effect of heat and mechanical treatment on the properties of metals.

"Some of these would properly be carried on in the materials testing laboratories, and closer coöperation between the so-called mechanics departments and the machine design department is desirable."

"It would be very fine if more of the experiments in the laboratory were laid out along the lines which you mention. However, we cannot always get what we want. It seems somewhat outside our province to try to define a policy for the laboratory.

"As conditions exist here we do not have the funds, space or equipment which we desire. We have to improve our opportunities the best we can with our available facilities.

"In any event, this is a goal worth striving to attain."

"I am most decidedly in favor of having the student perform tests in conjunction with the course in Machine Design. This will awaken the student's interest in correlating the derivation of the formulas, the application of these to actual problems, and then testing the results in the laboratory. The 14 tests which you mention are all very essential and should be performed wherever the facilities permit. Most institutions are, however, not in position at present to carry out the idea in full.

"I am of the opinion that some of the tests should be substituted for experiments in heat engines."

FRANK L. EIDMANN,
Chairman.

REPORT OF CONFERENCE ON ENGLISH *

The subject for discussion at the two sessions of the Conference on English was SPEECH TRAINING IN ENGINEERING SCHOOLS. The particular topics considered were:

The Need of Speech Training for Engineers.
Aims and Objectives in Speech Training for Engineering Students.
Debating and Discussion Groups among Engineering Students.
The Professional Society and Speech Training.
Speech Training through Classes in Technical Subjects.

These topics obviously covered the interest and experience of members with extended range—English teachers, instructors of technical subjects, administrative officers in technical schools, and practicing engineers, all of whom, it was pointed out, must have a part in giving all engineering students before graduation an opportunity not only for formal training but also for additional constant practice and a natural incentive for oral presentation of professional ideas and information. Granted a thorough knowledge of the technical subject upon which the normal student must speak in his everyday work in college and later, the objectives of speech training seem to be (1) the development of poise and self-confidence in this normal student, (2) clarity and force of expression, (3) audience consciousness.

The recognition on the part of the instructors of technical subjects of their responsibility in continuing the opportunity for practice, and in demanding acceptable presentation as well as accurate subject matter, and the offer of the aid of practicing engineers through the coöperation of professional societies have been extremely gratifying, and point to the ever-increasing tendency on the part of these two groups to indicate concretely to the engineering student that speech training carries over and through all his professional education long after the formal course has been completed. This growing solidarity in opinion and practice in all these groups extends, of course also, to the stressing in all written English the same objectives as for spoken-clarity and force of expression, audience consciousness.

Future plans of your Committee on English which should be mentioned in this report of the Conference on English at the 39th

* Presented at the 39th annual meeting, S. P. E. E., Purdue University, June 17–19, 1931.

annual meeting of the Society include a report on the present status of speech training in the engineering schools and colleges which is already well under way; a joint session at the 1932 annual meeting with the Division of Engineering Drawing in which a subject common to both English and Engineering Drawing will be discussed. And at the final session of the Conference on English, it was voted that a request for a Summer School for Teachers of English for Engineering Students in 1932 be sent to the Board of Investigation and Coördination.

Your Committee on English wishes on this occasion to express sincere appreciation of the interest and the active participation in the two sessions of the teachers of technical subjects, administrative officers and practicings, and also of their hearty coöperation with the activities of the Committee throughout the year. They have never failed to respond and aid whenever they have been called upon. We can be active, progressive, constructive in our thinking because of this backing.

Respectfully submitted,

SADA A. HARBARGER, *Chairman,*
Committee No. 12.

COLLEGE NOTES

Case School of Applied Science.—By appointment of President William E. Wickenden, Professor Clarence L. Eddy, until now professor of structural engineering, becomes professor of engineering administration and head of the new department of that title.

The purpose of the newly established department of engineering administration is to acquaint the seniors of all the engineering departments with methods of economic selection and with business organization and executive functions. The new course will be inaugurated at the beginning of the next college year.

Dr. Wickenden believes that in establishing this new department of engineering administration for the orientation of the Case seniors to the business world, Case is favorably augmenting the work in the department of economics, whose courses now include: Principles of Economics; Labor Problems; Business Finance; Industrial Relations; Accounting; and Investment. The first two of these courses are required of all Case Students; the others are offered as electives.

The course in Architecture established at **Rensselaer Polytechnic Institute** two years ago has resulted in the erection of a building for the use of the department of Architecture. It is a five story building and cost about $400,000. It is a valuable addition to the facilities of the Institute, not only for the instruction of students in Architecture but also because architectural subjects are now being given to the engineering students. The Architectural Building is a handsome structure. One unique feature of it is that it has set into the exterior of the building at the height of the second story fifteen tablets of stone giving the names of fifteen of the most distinguished American architects now deceased.

The building program for this year and next is quite an extensive one. Beside the Architectural Building an addition has been made to the Shop, used by mechanical and electrical engineers. This addition cost about $100,000.

Two dormitories are now under construction. These will house 170 students. A contract was let in August for five more dormitories and also for a new Club House, the latter will replace the old Club House and will be very useful in the social life of the students. It will contain rooms for the book committee, lounging room, billiard room, card room, reading room, rooms for the stu-

dent publications, a large room for dancing and other social purposes, and various committee rooms. All these buildings together will cost more than a million and a quarter dollars.

The Department of Business Administration at the Institute is flourishing. To take care of the development of this Department and especially to provide a thorough background in economics for all students in Engineering, Messrs. J. G. Yenchar, C. Louis Davis, T. Richard Witmer, and C. E. Goodman have been appointed to the staff.

Although most people in this district have become aware of the progress of Rensselaer Polytechnic Institute through the erection of new buildings and the growth of the student body, few have appreciated the corresponding increase in the faculty, now approaching 140 in number.

Because of its age and its prestige, it has always attracted many of the most promising students in engineering and science; and many of its ablest professors in these fields have naturally been and still are recruited from among its graduates, who have served acceptably on the faculties of many institutions. Like other institutions of similar rank, it also draws large numbers of its instructors from among its graduates, many of whom now continue their studies in the Graduate School. It has always sought, however, to secure the most competent teachers, irrespective of the institutions with which they have been connected. As a result some of its most distinguished professors of engineering have come from outside. The development of the departments of Arts, Science, and Business Administration and Architecture, making possible the enrichment of the engineering curricula, has likewise brought a corps of teachers who are specialists in the natural sciences, the social sciences, the humanities, and architecture. As is to be expected, they represent many colleges and universities in this and other countries.

University of Vermont.—Dean Frederick H. Sibley, University of Nevada, absent on leave is to have charge of the department of mechanical engineering for the year 1931–1932.

The late V. R. Yates, of the same department will be succeeded by William T. Fulton, class of '23, as associate professor. Mr. Fulton is now doing graduate work in mechanical engineering at Columbia. With the exception of a year spent in teaching Mr. Fulton, since his graduation, has been in charge of the New York office of Surface Combustion Co., Cleveland.

Worcester Polytechnic Institute.—For a period of at least five years, the Worcester Polytechnic Institute will make a substantial reduction in the number who are annually admitted to its entering

class. The size of entering classes in recent years has been about two hundred. In the future, the number will be limited to the one hundred and fifty applicants who appear to be best qualified to profit by an engineering education of the highest grade.

This limitation has been adopted after a long and careful study of modern trends in higher education, and of the position the Institute holds in the engineering field.

Engineering is a diversified profession, with constantly widening boundaries. There are many places in its field for young men of fair ability and limited training, a smaller number of commanding positions for men whose inherent superior ability has been developed through an educational process of the highest order. It is the aim of the Worcester Polytechnic Institute to be a source of supply for the potential leaders in the profession.

The Institute bases its decision to make this limitation of enrollment on a determination to provide the best possible engineering education for students of ability and ambition, and to free such men from the retarding influence of those who are inadequately equipped and poorly prepared.

In limiting its registration to students of superior qualifications, the Institute proposes, not to make its courses more rigorous, but to maintain the high standards of thoroughness in theory and practice for which the college has long been noted.

SECTIONS AND BRANCHES

The Annual Spring Meeting of the MIDDLE ATLANTIC SECTION of the Society for the Promotion of Engineering Education was held at Pratt Institute, Brooklyn, N. Y., Saturday, May 9, 1931.

Following registration a number of delegates went on inspection trips to the following places of interest:

Brooklyn Edison Company, Hudson Avenue Station.
Brooklyn Union Gas Company, Williamsburg Plant.
U. S. Navy Yard, Brooklyn.
Brooklyn Water Supply Tunnel.
Sperry Gyroscope Company, Brooklyn.
Brooklyn Polytechnic Institute, Brooklyn.

An excellent cafeteria luncheon was served in the Pratt Institute restaurant in Memorial Hall, complimentary to members and guests.

Chairman S. S. Edmands called the meeting to order at 2:20 P.M. in the Memorial Hall auditorium. The minutes of the Drexel Institute meeting of December 6, 1930, were read and approved. The treasurer reported a balance of $142.15 with all bills paid. Mr. Frederic B. Pratt, president of the Board of Trustees of Pratt Institute, welcomed the guests and told something of the origin and growth of the institute. A very fine illustrated exposition, on the subject, "Waves and Crystals," was given by Dr. Karl K. Darrow, Bell Telephone Laboratories. A very interesting round table conference was conducted by Dr. George B. Pegram of Columbia University, on the subject of "Jobs for June Graduates." This subject was discussed from many angles by Dr. Pegram, Dean Furman of Stevens Institute, Dean Mitchell of Syracuse, C. E. Davies of the A. S. M. E., Dean Barker of Columbia, Professor Hammond of Brooklyn Polytechnic Institute, Professor Nims of the Newark College of Engineering, Professor Bateman of Cooper Union, O. W. Eshbach of the American Telephone and Telegraph Company, George B. Thomas of the Bell Telephone Laboratories.

Chairman Edmands, speaking as Director of Pratt Institute, gave a brief introduction to the work of the Institute. Professor Dale of Pratt Institute, conducted the delegates through the laboratories and shops. Approximately 150 persons were present during the afternoon session.

Dinner was served in the Pratt Institute restaurant at six o'clock, and was attended by 110 persons.

At 7:15 Chairman Edmands reconvened the business session, and Professor H. P. Hammond spoke of the two S. P. E. E. summer schools to be held in 1931, one on Chemical Engineering at the University of Michigan, and the other on Mathematics at the University of Minnesota. Dean Furman of Stevens Institute spoke of innovations in the way of summer sessions to be conducted by Stevens, one for graduates of Stevens and Columbia, conducted jointly by the two institutions, on the subject of Economics, and a second for boys between the junior and senior years in high school for the purpose of helping in the decision as to character of college course to be pursued. Dr. Charles Scott of Yale spoke briefly on the development of engineering and the problems confronting engineers.

A committee appointed to draft a resolution to be sent to the family of Professor Irving Porter Church, and consisting of Albin H. Beyer, Charles F. Scott and H. P. Hammond, made the following report in the form of a telegram sent by the secretary of the section.

"Dean Dexter S. Kimball,
Cornell University,
Ithaca, N. Y.

The membership of the Middle Atlantic Section of the S. P. E. E. in session to-day desire you to express for them to the family of Professor Irving Porter Church the great esteem in which those engaged in engineering education have held Professor Church and his work as a teacher and author. His memory will long be honored for the profound effect he has exerted on engineering education and on the engineering profession and on engineering achievement.

CHARLES G. THATCHER,
Secretary."

This resolution was unanimously adopted.

The Committee on Meetings, consisting of Professors Berry of Pennsylvania, Hammond of Brooklyn Polytechnic, and Thatcher of Swarthmore, made the recommendation that the invitations of Lafayette for the 1931 fall meeting and of Swarthmore for the 1932 spring meeting be accepted. The recommendation was unanimously approved.

The Committee on Resolutions presented the following report, which was unanimously adopted:

Resolved: That the members of the Middle Atlantic Section of

the Society for the Promotion of Engineering Education hereby express to the faculty officers and trustees of the Pratt Institute their thanks and appreciation for the very enjoyable hospitality extended to the members on the occasion of their section meeting held May 9th at the Institute; to Messrs. Frederic B. Pratt, Samuel S. Edmands, Karl K. Darrow and H. V. Kaltenborn, for their work in connection with the meeting and their instructive and delightful addresses, and to the many industries who permitted and arranged for the instructive visits to their plants.

J. W. BARKER,
EDGAR S. BARNEY,
P. H. DAGGETT.

Mr. Charles Pratt, a member of the Board of Trustees of the Institute, welcomed the guests and spoke briefly in appreciation of the work of the S. P. E. E.

Mr. H. V. Kaltenborn gave a very illuminating and inspiring address on the subject, "We Look at the World."

CHARLES G. THATCHER, *Secretary.*

NECROLOGY

ARTHUR HENRY HOFFMAN, Agricultural Engineer in the Experiment Station, College of Agriculture, University of California, passed away on May 19, 1931. Professor Hoffman was born at Washington, Iowa, August 13, 1873, and received his education in that state. He took an A.B. degree from Iowa Wesleyan University in 1897 and his Master's degree from the same institution in 1905; also the same year he received a B.S. degree in Electrical Engineering from Iowa State College. In 1915 he received a B.S. degree in Agricultural Engineering from Iowa State College and the same year was awarded his professional degree in Electrical Engineering.

From 1905 to 1913 he taught physics at Iowa State College. The following two years he did special lecture and laboratory work at the College of Agriculture, Rutgers University, and also personal experimental work. In 1917–18 he was at New Mexico State College where he was in charge of Agricultural Engineering and special training work for the United States Transport Service.

He came to the University of California in 1919 as a research and experimental worker in which capacity he served continuously until his death. Professor Hoffman's most outstanding work was in connection with air cleaners for internal combustion engines. He was the first to standardize methods of testing and his advice was widely sought by the automotive and tractor industries. Engineers from all parts of the world visited his laboratories and studied his methods of testing.

He also conducted extensive studies on methods of orchard heating and at the time of his death he had experimental work under way to determine ways and means of smoke abatement from citrus orchard heating. In recent years he had taken up a study of the effectiveness of oil filters in preventing bearing wear in internal combustion engines. These studies were offering promise of similar interest and magnitude as his well known air cleaner investigations.

Mr. Hoffman was an active member in several technical and learned societies. He was a member of the American Society of Agricultural Engineers and for a number of years a member of its Council; member of the Society for the Promotion of Engineering Education, and a member of the Society of Automotive Engineers. He was a member of Phi Kappa Phi, Sigma Xi, and Gamma Sigma Delta honor societies. He was a Mason and a member of Beta Theta Pi social fraternity.

BOOK REVIEWS

Elements of Thermodynamics. By E. M. FERNALD, Assistant Professor of Mechanical Engineering, Lafayette College. 324 pages 6″ × 9″, 166 illustrations. McGraw-Hill Book Co., 1931, $3.50.

The story goes that a well-known professor of (and author of books on) mechanics, in his student days, had lots of trouble understanding his teachers, and vowed that, if he should ever be so unfortunate as to become a teacher, he would make his subject so clear that even the dullest student in the class could not help understanding. Professor Fernald's book appears to have been written with a similar purpose. The topics are discussed with a clearness and fullness that, in places, becomes boresome to the initiated, but is probably very helpful to the student.

The method of introduction and treatment of the entropy concept is masterly and will help the student to become almost chummy with the "ghostly quantity."

The author had the courage to break away from traditional terms. Very commendable is the use of the term "isentropic expansion" instead of "adiabatic expansion," which latter term was bequeathed to us by the old masters, Rankine and Zeuner; it was acceptable as long as we had reciprocating engines only, but is incorrect in the steam turbine age.

As the book stands now, its title might well be changed to "Thermodynamics of Steam Power Plants (with a few very short sections on other subjects)." In fact, Professor Fernald discusses the thermodynamics of steam powerplant cycles with a detail which is usually reserved for text books on steam power plants.

While steam power plants have been treated in great detail, other subjects have been dealt with in a rather stepfatherly manner. The treatment of the thermodynamics of the internal combustion engine is far from adequate. The air cycle standard is given for constant specific heat of air, but no statement is offered concerning the amount of error which is caused by the assumption. While the losses in steam power plants are enumerated in detail, such losses as radiation from burning gases to cool cylinder walls are not even mentioned.

In the thermodynamics of refrigeration equipment, the modern principle of using a mixture of ammonia and hydrogen is passed over in silence.

The thermodynamics of chemical reactions is not given any consideration.

Although flow through nozzles and orifices is studied, no mention is made of lack of thermal equilibrium, undercooling, and the Wilson line. True enough, the title is "Elements of Thermodynamics," but what good does it do (to use the words of Mr. Dooley) "to teach things that ain't so." The student should be told by what fraction elementary theory may be in error.

Professor Fernald's book will, doubtless, fit very well into some curricula, particularly into those which assign much time to thermodynamics, and less to steam power plants. There are curricula into which it will not fit, unless the book or curriculum is changed.

W. T.

Laboratory Manual of Physics. CLINTON MAURY KILBY. Pp. 129, 65 Experiments, D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, 1930. Price $1.75.

This manual is intended for students taking an introductory course of college physics. The author has endeavored to provide a set of experiments numerous enough to allow the instructor to select those suited to the equipment available and requiring only simple inexpensive apparatus. The experiments are exceedingly simple and are further simplified by the use of numerous illustrations.

This manual could be recommended for use in cultural courses such as are given in most colleges but seems too simple for engineering students.

R. E. S.